Original Contribution

Associations of Depressive Symptoms With All-Cause and Cause-Specific Mortality by Race in a Population of Low Socioeconomic Status: A Report From the Southern Community Cohort Study

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Depression is a leading cause of disability in the United States, but its impact on mortality rates among racially diverse populations of low socioeconomic status is largely unknown. Using data from the Southern Community Cohort Study, 2002–2015, we prospectively evaluated the associations of depressive symptoms with all-cause and cause-specific mortality in 67,781 Black (72.3%) and White (27.7%) adults, a population predominantly with a low socioeconomic status. Baseline depressive symptoms were assessed using the 10-item Center for Epidemiological Studies Depression Scale. The median follow-up time was 10.0 years. Multivariate Cox regression was used to estimate hazard ratios and 95% confidence intervals for death in association with depressive symptoms. Mild, moderate, and severe depressive symptoms were associated with increased all-cause (hazard ratio (HR) = 1.12, 95% confidence interval (CI): 1.03, 1.22; HR = 1.17, 95% CI: 1.06, 1.29; HR = 1.15, 95% CI: 1.03, 1.28, respectively) and cardiovascular disease–associated death (HR = 1.23, 95% CI: 1.05, 1.44; HR = 1.18, 95% CI: 0.98, 1.42; HR = 1.43, 95% CI: 1.17, 1.75, respectively) in Whites but not in Blacks (P for interaction < 0.001, for both). Mild, moderate, or severe depressive symptoms were associated with increased rates of external-cause mortality in both races (HR = 1.24, 95% CI: 1.05, 1.46; HR = 1.31, 95% CI: 1.06, 1.61; HR = 1.42, 95% CI: 1.11, 1.81, respectively; for all study subjects, P for interaction = 0.48). No association was observed for cancer-associated deaths. Our study showed that the association between depression and death differed by race and cause of death in individuals with a low socioeconomic status.

all-cause mortality; cause-specific mortality; depression; depressive symptoms; low-socioeconomic-status population; race; Southern Community Cohort Study

Abbreviations: CI, confidence interval; CESD-10, 10-item Center for Epidemiological Studies Depression Scale; CVD, cardiovascular disease; HR, hazard ratio; SCCS, Southern Community Cohort Study; SES, socioeconomic status.

Depression, a leading cause of disability worldwide (1–3), is often associated with chronic medical conditions and impaired occupational functioning and quality of life, placing a heavy burden on families, communities, and health service systems (4–6). In 2017, approximately 17.3 million adults in the United States had at least 1 major depressive episode (7). Depression is increasing globally and is a major global health concern (8).

Depression and/or depressive symptoms have been associated with increased all-cause and certain cause-specific mortality, such as cardiovascular disease (CVD)–

associated deaths (9–15). The vast majority of previous studies, however, were conducted in predominately White populations. Although Blacks are underrepresented in research and have less access to mental health services, particularly high-quality care, and are more likely to be exposed to a variety of stressors, studies have shown that Blacks have a lower lifetime risk of depression compared with Whites (16, 17). Low socioeconomic status (SES) was associated with 80% increased odds of depression in a meta-analysis (18). A wide racial gap in SES exists, which may affect psychological health and its association with death (16, 17).

Research addressing racial differences relative to the depression–death association is scant, and results are mixed (19–22).

In this study, we comprehensively evaluated the associations of depressive symptoms with all-cause and cause-specific mortality among a cohort of Whites and Blacks with similar SES backgrounds. We also examined whether demographics, lifestyle factors, medical comorbidities, and religious factors modified the association between depression and death.

METHODS

Study population

We used resources from the Southern Community Cohort Study (SCCS), a landmark epidemiologic study designed to investigate health disparities in a low-income and underserved population. Details of the study design and implementation have been reported (23). Briefly, between 2002 and 2009, the SCCS enrolled approximately 86,000 adults (approximately two-thirds of whom were Black), aged 40–79 years, living in 12 southeastern states. Approximately 86% of participants ($n = 73,700$) were recruited through community health centers that provide medical and preventive care mainly to medically underserved and low-income individuals. The remaining 14.3% were recruited from the general population via mailed surveys. The present study only included participants recruited from community health centers ($n = 67,781$; 72.3% Black and 27.7% White). Participants completed comprehensive baseline in-person interviews, conducted by trained interviewers, from which information on demographics, SES, lifestyle factors, medical histories, and depressive symptoms was collected. Race was self-reported. The SCCS was approved by the institutional review boards at Vanderbilt University and Meharry Medical College. All participants provided written informed consent.

Measurement of depressive symptoms

Baseline depressive symptoms were assessed using the 10-item Center for Epidemiological Studies Depression Scale (CESD-10), a valid and reliable instrument for measuring the current presence and severity of depressive symptoms (24–26), with a demonstrated measurement equivalency across a broad range of ages and ethnicities (27, 28). During baseline interviews, participants were asked how often they felt bothered, had trouble keeping their minds focused, felt depressed, felt that everything was an effort, felt fearful, slept restlessly, felt lonely, could not get going, felt hopeful, and were happy during the past week. Responses (4 categories to each item, score 0–3) to the CESD-10 were scored, with summarized scores ranging from 0–30. CESD-10 scores were then categorized as ranging from 0 to < 10, 10 to < 15, 15 to < 20, and ≥ 20 , as indicating no, mild, moderate, or severe depressive symptoms, respectively (29, 30). In addition, participants were asked, “Has a doctor ever told you that you had depression?” (yes/no)

and “Are you currently taking any antidepressant or anti-anxiety prescription medication, such as Prozac (Eli Lilly, Indianapolis, Indiana), Zoloft (Pfizer, New York, New York), Paxil (GlaxoSmithKline, Brentford, United Kingdom) or Buspar (Mylans, Canonsburg, Pennsylvania)?” (yes/no).

Outcome ascertainment

The end points of our study were all-cause mortality and cause-specific mortality, including deaths due to CVD, cancer, and external causes. Information on dates and causes of death was ascertained via linkage of the SCCS roster with both the Social Security Administration’s vital status service and National Death Index through December 31, 2015. Underlying causes of death were coded using the *International Classification of Diseases, Tenth Revision*. Causes of death grouped into CVD-associated deaths included codes I00–I99, causes of death grouped into cancer-associated death included codes C00–C97, and external causes of death included codes V01–Y98 (31). Person-years of follow-up began on the participants’ enrollment date and continued through the date of death or December 31, 2015, whichever occurred first.

Statistical analyses

Descriptive statistics (means and proportions) were used to describe the distributions of study variables. The χ^2 test (for categorical data) and analysis of variance (for continuous data) were applied to examine differences in participant characteristics. Multivariate Cox regression models were used to estimate hazard ratios and 95% confidence intervals for all-cause and cause-specific mortality associated with depressive symptoms. Adjusted covariates included age, race, sex, comorbidity score, marital status, educational attainment, annual household income, neighborhood deprivation index (32), cigarette-smoking status, alcohol consumption, body mass index (calculated as weight (kg)/height (m^2)), amount of physical exercise (metabolic-equivalent hours per week), and spiritual/religious beliefs (including frequency of attending religious or faith-based services, perceived spirituality or religiosity, and “how much is religion, faith or God a source of strength and comfort to you?”). Comorbidity scores applied in the study were derived from a modified Charlson Comorbidity Index, which summed the number of self-reported disease history on heart attack or coronary artery bypass surgery, stroke, chronic obstructive pulmonary disease, asthma, tuberculosis, hepatitis, ulcer, diabetes, Parkinson disease, high cholesterol level, hypertension, arthritis, inflammatory bowel disease, multiple sclerosis, lupus, cancer, and acquired immunodeficiency syndrome (33, 34). Because depression diagnosis and antidepressant or anti-anxiety medications may influence the presence of depressive symptoms and, thus, CESD-10 scores, we also conducted sensitivity analyses by inclusion of these 2 factors in the Cox regression model to evaluate the influence of undiagnosed or uncontrolled depression symptoms on death. The trend test was evaluated by treating the depression score as a continuous variable in the analysis. Multiplicative

interactions were evaluated by including the product terms of the depression score (continuous) and variables of interest in Cox regression models. All variables included in the analyses had very low rates of missing or unknown data (0%–1.0%). We assigned participants with missing or unknown data to the subgroup with the highest frequency. All analyses were conducted using Statistical Analysis Software, version 9.1 (SAS Institute Inc., Cary, North Carolina). All statistical tests were based on a 2-sided probability, with $P < 0.05$ considered statistically significant.

RESULTS

The median follow-up time for 67,781 study participants was 10.0 years (interquartile range = 4 years). [Table 1](#) lists characteristics of study participants. Participants' mean age was 51.7 years at study enrollment, and the majority (61.4%) had annual household incomes of < \$15,000. Among all participants, 42.1% had at least mild symptoms of depression (CESD-10 score ≥ 10), 18.7% reported the current use of antidepressant or antianxiety medications, and 25.0% reported ever having been diagnosed with depression. Compared with Whites, Blacks were less likely to have moderate or severe depressive symptoms, be diagnosed with depression by a doctor, and currently taking antidepressant or antianxiety medications. Blacks were also less likely to be married, exercise regularly, have ever smoked cigarettes, and have comorbidity index scores ≥ 3 ; however, they were more likely to have educational levels less than high school, very low household incomes (< \$15,000), have ever been alcohol drinkers, and live in neighborhoods with high deprivation index scores. In addition, Blacks were more likely to attend religious or faith-based services; use religion, faith, or God as sources of strength and comfort; and perceive self as spiritual or religious.

Overall, women, ever smokers, ever alcohol drinkers, nonexercisers, those who were unmarried, those living in more deprived neighborhoods, current users of antidepressant or antianxiety medications, those with very low incomes, less education, body mass index ≥ 35 , comorbidities, no or less religious involvement (e.g., service attendance, perceived spirituality or religiosity), or self-reported history of depression were more likely to have higher CESD-10 scores compared with their counterparts ($P < 0.001$ for all) ([Table 2](#)). Whites had higher CESD-10 scores than did Blacks, in general and across almost all subgroups examined, with few exceptions, such as in subgroups of people who were current users of antidepressant or antianxiety medications, had incomes $\geq \$50,000$, had no comorbidities, and exercised regularly, where no significant differences were observed.

[Table 3](#) lists associations of depressive symptoms with all-cause and cause-specific mortality. Overall, depressive symptoms were positively associated with all-cause mortality ($P = 0.02$), an association only seen in Whites (hazard ratio (HR) = 1.12, 95% confidence interval (CI): 1.03, 1.22; HR = 1.17, 95% CI: 1.06, 1.29; HR = 1.15, 95% CI: 1.03, 1.28, for mild, moderate, and severe depressive symptoms, respectively), but not in Blacks (P for interaction < 0.001).

Cause-specific mortality analysis revealed 3 association patterns. For CVD, depressive symptoms were associated with an increased CVD-related death only in Whites ($P = 0.003$; HR = 1.23, 95% CI: 1.05, 1.44, for mild depression; HR = 1.18, 95% CI: 0.98, 1.42, for moderate depression; and HR = 1.43, 95% CI: 1.17, 1.75, for severe depression). Analysis revealed null associations for data from Blacks and when Whites and Blacks were combined. Depressive symptoms were associated with increased rates of external-cause mortality overall (HR = 1.25, 95% CI: 1.06, 1.48, for mild depression; HR = 1.32, 95% CI: 1.07, 1.62, for moderate depression; and HR = 1.42, 95% CI: 1.12, 1.82, for severe depression) and in both Whites and Blacks (P for interaction = 0.49). For cancer, no associations were found for either race. Sensitivity analysis with additional adjustment for self-reported depression diagnosis and current use of antidepressant or antianxiety medications yielded very similar results ([Web Table 1](#)) (available at <https://doi.org/10.1093/aje/kwaa216>). To minimize the concern about potential reverse causation by baseline health status, we also conducted sensitivity analyses by excluding the first 2 years of cohort observation after study enrollment, and the aforementioned association patterns persisted ([Web Table 2](#)).

We further examined associations between depressive symptoms and CVD-related death in Whites stratified by demographics, SES, lifestyle, comorbidity index, and religious factors ([Table 4](#)). The association of depression with CVD-related death was modified by income and comorbidity; a stronger association was observed among individuals with annual household incomes > \$15,000, or those with ≥ 3 comorbidities. In general, depression symptoms were not positively associated with CVD death across subgroups of Black participants (data not shown). Analyses did not reveal any significant 3-way interactions (data not shown).

Because no racial differences were observed for depression-related external-cause death, effect modifications were evaluated by combining data from Whites and Blacks ([Table 5](#)). Significant effect modifications were observed for education, exercise, and comorbidity score. The association of depression and external-cause death was stronger among individuals who had educational levels of high school or more, reported high levels of exercise (metabolic-equivalent hours/week > 31.5), or had no comorbidities.

DISCUSSION

Substantial evidence shows that depression and/or depressive symptoms are risk factors for all-cause mortality. In a meta-analysis of 293 studies conducted in 35 countries, depression was associated with a 50% increased risk of death (9). In the United States, most of the existing evidence was derived from predominantly White populations, and very few studies have investigated racial differences regarding the influence of depressive symptoms on death outcomes (19, 22). The American's Changing Lives study, a nationally representative longitudinal cohort of 3,361 US adults aged ≥ 65 years, with 34.4% Black participants, showed that

Table 1. Participant Characteristics at Baseline, Overall ($n = 67,781$), and by Race, the Southern Community Cohort Study, 2002–2009

Participant Characteristic	All Participants, Whites ($n = 18,770$, 27.7%), Blacks ($n = 49,011$, 72.3%), %			P Value ^a
Age at enrollment, years ^b	51.7 (8.8)	53.2 (9.2)	51.2 (8.5)	<0.001
Depression according to CESD-10 score ^c				
No depression	57.9	54.2	59.3	<0.001
Mild depression	23.2	21.2	24.0	
Moderate depression	11.8	13.7	11.1	
Severe depression	7.1	10.9	5.6	
Self-reported history of depression diagnosis by a doctor				
No	75.0	58.8	81.2	<0.001
Yes	25.0	41.2	18.8	
Current use of antidepressants or antianxiety medications				
No	81.3	66.6	86.9	<0.001
Yes	18.7	33.4	13.1	
Sex				
Male	39.6	34.7	41.5	<0.001
Female	60.4	65.3	58.5	
Annual household income, USD				
<15,000	61.4	57.3	63.0	<0.001
15,000–24,999	21.8	20.4	22.3	
25,000–49,999	11.9	13.8	11.1	
≥50,000	4.9	8.7	3.6	
Education				
≤ 11 years	32.0	29.0	33.2	<0.001
12 years, high school graduate, or equivalent	35.3	35.4	35.3	
> High school	32.7	35.6	31.5	
Marital status				
Married or living with partner	31.7	42.5	27.5	<0.001
Separated, divorced, or single and never married	68.3	57.5	72.5	
Body mass index ^d				
<25.0	25.5	26.4	25.1	0.002
25.0–29.9	28.8	28.6	28.9	
≥30.0	45.7	45.0	46.0	
Cigarette-smoking status				
Never smoker	34.8	30.6	36.4	<0.001
Ever smoker	65.2	69.4	63.6	
Alcohol consumption				
Never drinker	47.7	54.0	45.3	<0.001
Ever drinker	52.3	46.0	54.7	
Physical exercise (metabolic-equivalent hours/week), %				
No exercise	71.1	75.4	69.5	<0.001
Regular exercise				
0.1–7.4	5.1	3.6	5.6	
7.5–16.0	7.4	6.0	8.0	
16.1–31.5	8.0	6.9	8.4	
>31.5	8.4	8.1	8.5	

Table continues

Table 1. Continued

Participant Characteristic	All Participants, Whites (n = 18,770, 27.7%), Blacks (n = 49,011, 72.3%), %			P Value ^a
How often attending religious or faith-based services				
Never, holidays only, >4 times/year but <1/week	50.2	61.0	46.1	<0.001
At least once a week	49.8	39.0	53.9	
Perceived spirituality or religiosity				
Not at all, slightly, fairly spiritual or religious	44.0	48.1	42.5	<0.001
Very spiritual or religious	56.0	51.9	57.5	
How much is religion, faith, or God a source of strength and comfort to you?				
Not very much, somewhat, quite a bit	30.8	44.8	25.4	<0.001
Great deal	69.2	55.2	74.6	
Deprivation index (quartile), %				
1 (least deprived)	8.3	16.7	5.1	<0.001
2	14.7	28.0	9.5	
3	20.3	29.9	16.7	
4 (most deprived)	56.7	25.4	68.7	
Comorbidity index score				
0	18.1	14.5	19.5	<0.001
1–2	50.8	47.0	52.3	
≥3	31.1	38.5	28.2	

Abbreviation: CESD-10, 10-item Center for Epidemiological Studies Depression Scale.

^a χ^2 test (for categorical data) and analysis of variance (for continuous data) were used to test for significant differences in baseline depressive symptoms and other characteristics between Whites and Blacks.

^b Values are expressed as mean (standard deviation).

^c CESD-10 score: no depression, < 10; mild depression, 10–14.9; moderate depression, 15–19.9; severe depression, ≥ 20.

^d Weight (kg)/height (m²).

depressive symptoms were associated with increased all-cause mortality and death from renal diseases only among Whites, not Blacks (22, 35, 36). Similarly, a recent study with 43% Black participants reported that depressive symptoms were associated with higher all-cause mortality among Whites but not Blacks (19). In our analysis of 67,719 SCCS participants, 72.3% of whom were Black, and with an average 10 years of follow-up, we found a statistically significant association of depression, with approximately a 15% increased risk of all-cause mortality in Whites and a null association in Blacks. We found positive associations between depression and all-cause and CVD-associated mortality that existed in Whites, even when depression symptoms were mild, consistent with previous reports (37, 38). Our data support the notion that depressive symptoms influence death differently between Whites and Blacks, with Whites being primarily affected.

Depression and/or depressive symptoms have been consistently associated with CVD risk and poor outcomes (11–14), although few studies have examined potential racial differences in the associations. In our study, we found that depression was associated with increased CVD-related mortality rates only in Whites. Our finding is supported by the Health and Retirement Study, a nationally representative

longitudinal survey of 15,845 US adults, aged ≥ 50 years (15.2% Black participants), in whom, after an average 9.2 years of follow-up, depressive symptoms were statistically significantly associated with elevated total CVD-associated mortality rates in Whites but not in Blacks (21). However, the Chicago Health and Aging Project, involving 12 years of follow-up of 6,158 community-dwelling, older (aged ≥ 65 years) adults (62% Black), reported that depressive symptoms were associated with a 2-fold elevated CVD-associated mortality rate only in Blacks.

Biological and behavioral mechanisms have been hypothesized to explain the potential link between depression and CVD risk (39, 40). Depression has been associated with increased activity of the sympathetic nervous system and hypothalamic–pituitary–adrenal axis, platelet activation, and inflammatory markers, as well as endothelial dysfunction and decreased heart rate variability, leading to the development of dyslipidemia, hypertension, diabetes, and nonfatal CVDs—chronic medical conditions that are well-established risk factors for CVDs (39). Depression has also been associated with poor adherence to cardiovascular medications and unhealthy lifestyle factors, such as physical inactivity and smoking, which may mediate the association between depression and poor prognosis (40). In our study,

Table 2. CESD-10 Scores by Participant Characteristics, Overall ($n = 67,781$), and in Whites and Blacks; the Southern Community Cohort Study, 2002–2009

Variable	CESD-10 Score, Mean (Standard Deviation)			P1 Value ^a
	Overall	Whites ($n = 18,770$)	Blacks ($n = 49,011$)	
CESD-10 score overall and by race	9.2 (6.1)	10.0 (6.7)	8.9 (5.8)	<0.001
Self-reported history of depression diagnosis by a doctor				
No	7.9 (5.3)	7.7 (5.6)	8.0 (5.3)	<0.001
Yes	13.0 (6.5)	13.2 (6.9)	12.8 (6.3)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Current use of antidepressants or antianxiety medications				
No	8.3 (5.6)	8.5 (6.1)	8.3 (5.4)	<0.001
Yes	12.9 (6.7)	12.9 (6.9)	12.8 (6.4)	0.23
P2 value ^b	<0.001	<0.001	<0.001	
Sex				
Male	8.6 (5.6)	9.3 (6.2)	8.4 (5.3)	<0.001
Female	9.5 (6.4)	10.3 (6.9)	9.2 (6.1)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Education				
≤11 years	10.2 (6.1)	11.3 (6.8)	9.9 (5.9)	<0.001
12 years, high school graduate or equivalent	9.3 (6.0)	10.1 (6.6)	8.9 (5.6)	<0.001
>High school	8.1 (5.9)	8.7 (6.5)	7.8 (5.6)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Annual household income, USD				
<15,000	10.0 (6.2)	11.2 (6.8)	9.6 (5.9)	<0.001
15,000–24,999	8.5 (5.6)	9.5 (6.3)	8.2 (5.4)	<0.001
25,000–49,999	7.4 (5.6)	8.0 (6.2)	7.0 (5.2)	<0.001
≥50,000	5.4 (5.0)	5.8 (5.0)	5.7 (5.0)	0.31
P2 value ^b	<0.001	<0.001	<0.001	
Marital status				
Married or living with partner	8.2 (5.9)	8.8 (6.3)	7.9 (5.6)	<0.001
Separated, divorced or single and never married	9.6 (6.1)	10.9 (6.8)	9.2 (5.8)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Body mass index, % ^c				
<25.0	9.2 (6.0)	9.6 (6.8)	9.1 (5.6)	<0.001
25.0–29.9	8.8 (5.9)	9.6 (6.6)	8.6 (5.7)	<0.001
≥30.0	9.4 (6.2)	10.4 (6.7)	9.0 (5.9)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Cigarette smoking status				
Never smoker	8.5 (5.9)	8.9 (6.4)	8.3 (5.7)	<0.001
Ever smoker	9.6 (6.1)	10.4 (6.8)	9.2 (5.8)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Alcohol consumption				
Never drinker	9.0 (6.2)	10.1 (6.7)	8.5 (5.9)	<0.001
Ever drinker	9.4 (6.0)	9.9 (6.7)	9.2 (5.4)	<0.001
P2 value ^b	<0.001	0.073	<0.001	

Table continues

Table 2. Continued

Variable	CESD-10 Score, Mean (Standard Deviation)			P1 Value ^a
	Overall	Whites (n = 18,770)	Blacks (n = 49,011)	
Physical exercise (metabolic-equivalent hours/week)				
No regular exercise	9.6 (6.2)	10.6 (6.8)	9.2 (5.9)	<0.001
Regular exercise				
0.1–7.4	8.4 (5.6)	8.5 (6.0)	8.3 (5.5)	0.33
7.5–16.0	8.2 (5.6)	8.3 (6.1)	8.2 (5.4)	0.55
16.1–31.5	8.1 (5.5)	8.0 (6.0)	8.1 (5.3)	0.63
>31.5	8.2 (5.6)	8.0 (6.0)	8.2 (5.4)	0.23
P2 value ^b	<0.001	<0.001	<0.001	
How often attending religious or faith-based services				
Never, holidays only, >4 times/year but <1/week	10.0 (6.2)	10.9 (6.8)	9.5 (5.8)	<0.001
At least once a week	8.4 (5.8)	8.5 (6.3)	8.3 (5.7)	0.002
P1 value ^b	<0.001	<0.001	<0.001	
Perceived spirituality or religiosity				
Not at all, slightly, fairly spiritual or religious	9.9 (6.1)	10.6 (6.7)	9.6 (5.8)	<0.001
Very spiritual or religious	8.6 (6.0)	9.4 (6.7)	8.3 (5.7)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
How much is religion, faith, or God a source of strength and comfort to you?				
Not very much, somewhat, quite a bit	10.2 (6.1)	10.8 (6.7)	9.9 (5.7)	<0.001
Great deal	8.7 (6.0)	9.3 (6.6)	8.5 (5.8)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Deprivation index (quartile)				
1 (least deprived)	8.7 (6.4)	9.2 (6.8)	8.1 (5.8)	<0.001
2	9.2 (6.3)	9.9 (6.8)	8.3 (5.7)	<0.001
3	9.2 (6.2)	10.0 (6.7)	8.5 (5.8)	<0.001
4 (most deprived)	9.3 (5.9)	10.4 (6.6)	9.1 (5.8)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	
Comorbidity index score				
0	7.8 (5.4)	7.6 (5.8)	7.8 (5.3)	0.11
1–2	8.9 (5.9)	9.6 (6.6)	8.6 (5.7)	<0.001
≥3	10.5 (6.4)	11.4 (6.9)	10.1 (6.1)	<0.001
P2 value ^b	<0.001	<0.001	<0.001	

Abbreviation: CESD-10, 10-item Center for Epidemiological Studies Depression Scale.

^a P1 value was derived from analysis of variance for testing differences in CESD-10 scores between Whites and Blacks.

^b P2 value was derived from analysis of variance for testing differences in CESD-10 scores between subgroups within a variable of interest.

^c Weight (kg)/height (m²).

we found that the association of depression and CVD-related death was modified by income and comorbidity score in Whites but not in Blacks, suggesting that sociodemographic and health factors have different influences on depression outcomes in Whites and Blacks. We did not observe that other lifestyle factors (e.g., smoking, drinking, religious beliefs/practices) modified the depression–CVD association.

Prior studies investigating the relationship between depression and death resulting from cancer have generated mixed findings (41–44). In a recent meta-analysis, researchers reported that depression was associated with increased overall mortality rates among patients with cancer; however, only in approximately 40% of included studies were the results controlled for age and sex, and when only studies that controlled for potential confounding factors

Table 3. Association of Depression With All-Cause and Cause-Specific Mortality, Overall and by Race, ($n = 67,781$), the Southern Community Cohort Study, 2002–2009

Variable	All Participants				Whites				Blacks			
	Event	All	aHR ^a	95% CI	Event	All	aHR ^a	95% CI	Event	All	aHR ^a	95% CI
All-cause death												
No depression ^b	6,879	39,242	1.00	Referent	1,839	10,176	1.00	Referent	5,040	29,066	1.00	Referent
Mild depression	3,032	15,716	1.05	1.00, 1.09	860	3,980	1.12	1.03, 1.22	2,172	11,739	1.02	0.97, 1.08
Moderate depression	1,547	8,023	1.06	1.00, 1.12	584	2,567	1.17	1.06, 1.29	963	5,456	1.01	0.94, 1.09
Severe depression	906	4,800	1.05	0.98, 1.13	446	2,047	1.15	1.03, 1.28	460	2,750	0.97	0.88, 1.07
<i>P</i> for trend ^c				0.01				<0.001				0.81
<i>P</i> for interaction ^d								<0.001				
Cardiovascular disease–related death												
No depression ^b	2,178	39,242	1.00	Referent	497	10,176	1.00	Referent	1,686	29,066	1.00	Referent
Mild depression	937	15,716	1.04	0.96, 1.13	249	3,980	1.23	1.05, 1.44	688	11,739	0.98	0.90, 1.08
Moderate depression	457	8,023	1.03	0.93, 1.15	153	2,567	1.18	0.98, 1.42	304	5,456	0.98	0.87, 1.12
Severe depression	269	4,800	1.05	0.92, 1.20	138	2,047	1.43	1.17, 1.75	131	2,750	0.85	0.71, 1.02
<i>P</i> for trend ^c				0.36				0.003				0.27
<i>P</i> for interaction ^d								<0.001				
Cancer death												
No depression ^b	1,722	39,242	1.00	Referent	473	10,176	1.00	Referent	1,285	29,066	1.00	Referent
Mild depression	672	15,716	0.99	0.91, 1.09	177	3,980	1.03	0.86, 1.23	496	11,739	0.98	0.88, 1.09
Moderate depression	316	8,023	0.96	0.85, 1.09	114	2,567	1.03	0.83, 1.27	202	5,456	0.92	0.79, 1.07
Severe depression	167	4,800	0.90	0.77, 1.06	71	2,047	0.85	0.65, 1.10	96	2,750	0.92	0.74, 1.13
<i>P</i> for trend ^c				0.13				0.27				0.16
<i>P</i> for interaction ^d								0.17				
Death due to external causes												
No depression ^b	390	39,242	1.00	Referent	154	10,176	1.00	Referent	236	29,066	1.00	Referent
Mild depression	222	15,716	1.25	1.06, 1.48	83	3,980	1.21	0.93, 1.59	137	11,739	1.26	1.02, 1.56
Moderate depression	125	8,023	1.32	1.32, 1.62	64	2,567	1.39	1.03, 1.89	61	5,456	1.24	0.93, 1.65
Severe depression	86	4,800	1.42	1.12, 1.82	56	2,047	1.47	1.47, 2.03	30	2,750	1.31	1.31, 1.93
<i>P</i> for trend ^c				<0.001				0.004				0.03
<i>P</i> for interaction ^d								0.49				

Abbreviations: aHR, adjusted hazard ratio; CI, confidence interval.

^a Adjusting for age at enrollment, race, sex, education, household income, marital status, body mass index, smoking status, alcohol consumption, regular exercise, comorbidity index score, deprivation index score, frequency of attending religious or faith services, perceived spirituality or religiosity, and use of religion, faith, or God as a source of strength and comfort.^b CESD-10 score: no depression, < 10; mild depression, 10–14.9; moderate depression, 15–19.9; severe depression, ≥ 20.^c *P* for trend refers to *P* for trend that was evaluated by treating CESD-10 score as a continuous variable in the analysis.^d *P* for interaction refers to *P* value for interaction between depressive symptoms (CESD-10 score, continuous variable) and race (White, Black).

Table 4. Association Between Depression and Cardiovascular Disease–Related Death in Whites Stratified by Sociodemographic-, Lifestyle-, Religion-, and Health-Related Factors, ($n = 18,770$), the Southern Community Cohort Study, 2002–2009

Variable	Event	All	Symptom Severity						P for interaction ^c
			Mild Depression ^a		Moderate Depression ^a		Severe Depression ^a		
			aHR ^b	95% CI	aHR ^b	95% CI	aHR ^b	95% CI	
Sex									
Female	508	12,256	1.24	0.99, 1.56	1.09	0.84, 1.43	1.35	1.03, 1.78	0.42
Male	529	6,514	1.21	0.97, 1.50	1.24	0.96, 1.62	1.51	1.12, 2.04	
Educational level									
<High school	380	5,450	1.16	0.90, 1.50	0.96	0.70, 1.32	1.37	1.00, 1.87	0.35
≥High school	657	13,320	1.27	1.04, 1.55	1.31	1.04, 1.66	1.44	1.11, 1.88	
Annual income, USD									
<15,000	716	10,745	1.18	0.98, 1.42	1.08	0.87, 1.34	1.27	1.00, 1.60	0.03
≥15,000	321	8,025	1.34	1.00, 1.80	1.42	0.99, 2.04	2.00	1.35, 2.97	
Marital status									
Married or living with partner	384	7,982	1.02	0.78, 1.34	1.12	0.81, 1.54	1.30	0.89, 1.89	0.54
Separated, divorced, or single and never married	653	10,788	1.37	1.13, 1.66	1.22	0.97, 1.54	1.51	1.19, 1.92	
Body mass index, % ^d									
<25.0	238	4,959	1.09	0.78, 1.54	1.39	0.96, 2.03	1.11	0.71, 1.75	0.36
25.0–29.9	289	5,364	1.19	0.89, 1.59	0.95	0.63, 1.41	1.53	1.04, 2.25	
≥30.0	510	8,447	1.33	1.06, 1.66	1.22	0.93, 1.58	1.54	1.16, 2.03	
Regular exercise (metabolic-equivalent hours/week)									
<7.5	897	14,826	1.26	1.07, 1.49	1.20	0.98, 1.46	1.44	1.16, 1.78	0.20
7.5–31.5	93	2,431	0.83	0.48, 1.44	0.54	0.23, 1.28	1.20	0.53, 2.70	
>31.5	47	1,513	1.66	0.78, 3.53	2.12	0.92, 4.85	2.56	0.93, 7.06	
Alcohol consumption									
Never drinker	638	10,142	1.26	1.03, 1.53	1.21	0.95, 1.53	1.38	1.06, 1.79	0.98
Ever drinker	399	8,628	1.19	0.92, 1.53	1.10	0.81, 1.49	1.48	1.08, 2.03	
Cigarette-smoking status									
Never smoker	225	5,745	1.48	1.06, 2.06	1.57	1.05, 2.35	1.76	1.09, 2.84	0.64
Ever smoker	812	13,025	1.17	0.98, 1.40	1.09	0.88, 1.35	1.36	1.09, 1.69	
Comorbidity index score									
0	71	2,725	1.28	0.70, 2.34	1.42	0.65, 3.09	0.72	0.17, 3.03	0.04
1–2	600	12,171	1.08	0.83, 1.41	1.20	0.88, 1.65	1.05	0.71, 1.56	
≥3	356	3,716	1.33	1.09, 1.64	1.15	0.90, 1.47	1.66	1.30, 2.13	
Attending religious or faith-based services									
Never or occasional	663	11,443	1.29	1.06, 1.57	1.18	0.93, 1.48	1.58	1.25, 1.99	0.37
≥1/week	374	7,327	1.14	0.88, 1.48	1.20	0.86, 1.66	1.07	0.70, 1.63	
How much is religion, faith, or God a source of strength and comfort to you?									
Not very much, somewhat, quite a bit	522	8,400	1.26	1.01, 1.57	1.14	0.88, 1.48	1.55	1.18, 2.03	0.83
Great deal	515	10,370	1.21	0.97, 1.52	1.25	0.95, 1.64	1.29	0.95, 1.75	

Table continues

Table 4. Continued

Variable	Event	All	Symptom Severity						P for interaction ^c	
			Mild Depression ^a		Moderate Depression ^a		Severe Depression ^a			
			aHR ^b	95% CI	aHR ^b	95% CI	aHR ^b	95% CI		
Perceived spirituality or religiosity										
Not at all, slightly, fairly spiritual or religious	530	9,033	1.25	1.01, 1.56	1.09	0.84, 1.42	1.47	1.12, 1.92		0.97
Very spiritual or religious	507	9,737	1.20	0.96, 1.51	1.27	0.97, 1.67	1.35	1.00, 1.83		
Deprivation index										
Less than the median (less deprived)	413	8,394	1.07	0.82, 1.39	1.45	1.10, 1.93	1.55	1.14, 2.12		0.16
Greater than the median (more deprived)	624	10,376	1.32	1.09, 1.60	1.02	0.79, 1.31	1.36	1.04, 1.77		

Abbreviations: aHR, adjusted hazard ratio; CESD-10, 10-item Center for Epidemiological Studies Depression Scale; CI, confidence interval.

^a CESD-10 score: no depression, <10.0; mild depression, 10.0–14.9; moderate depression, 15.0–19.9; severe depression, ≥ 20.0.

^b Adjusting for age and other variables included in the table.

^c P for interaction refers to P for interaction between depressive symptoms (CESD-10 score, continuous variable) and variables of interest.

^d Weight (kg)/height (m²).

(at least for age and sex) were analyzed, no statistically significant associations were observed (10). We found, after comprehensively controlling for potential confounding factors, particularly SES, that depressive symptoms were not associated with increased cancer-related mortality rates in both Whites and Blacks.

Information on the association of depressive symptoms with external-cause death in underserved groups is seriously lacking. We confirmed results of an earlier report from the SCCS (34) that depression was associated with increased mortality rates due to external causes in White people and Black people. Interestingly, we observed that associations of depression with external-cause death vary with physical exercise status. Regular exercise has been associated with reduced all-cause mortality and death resulting from CVD in the general population (45). The Physical Activity Guidelines for Americans recommends 150 minutes/week of moderate-intensity exercise, or 75 minutes/week of vigorous-intensity exercise as the minimum amount required to maintain or improve health (46). However, it is unclear whether this recommendation applies to subgroup populations, such as individuals with depression. In the SCCS, although the association between depression and CVD-related death was not modified by exercise, the association for external-cause death was substantially stronger among those with a higher level of physical activity. The reason (or reasons) for this interaction is unclear but could be related to a greater accident potential among those with high levels of recreational physical activity. The association of depression with external-cause death was also stronger among individuals without comorbidities and those who had higher education levels. More research is needed to reveal the underlying mechanisms.

In previous studies and our study, the prevalence of depression was lower in Blacks than Whites, although Blacks are more frequently exposed to a wide range of stressors (17). The underlying mechanisms for this paradoxical phenomenon, however, remain to be determined. It has been suggested that religious practices (e.g., service attendance, religious coping) may have a protective effect against depression (17, 47, 48). Assari et al. (17) have shown that religious social support may protect against depression among Blacks more so than Whites. In line with previous studies, we found in the SCCS that attending or being involved in religious or faith-based services was associated with lower depression scores for Whites and Blacks. We also found that Blacks were more likely to attend religious or faith-based services; use religion, faith, or God for strength and comfort; and perceive themselves as very spiritual or religious. However, we did not find that religious practices modified the depression–death association for all-cause or cause-specific mortality.

This study has a number of strengths. The SCCS participant cohort comprises primarily Black adults and White adults of low SES, which provides a unique opportunity for investigating health-related racial disparities less confounded by SES than in other studies. The large sample size of the study and rich baseline information about demographics, SES, lifestyle, and health-related variables allowed us to evaluate many potential confounding factors and effect modifiers. Furthermore, the prospective design, with essentially complete follow-up for death, minimized selection bias.

Our study also has several limitations. First, we only had 1 depression measure, which limited our ability to evaluate the impact of change of depressive symptoms on death.

Table 5. Association between Depression and External-Cause Death in All Participants, Stratified by Sociodemographic-, Lifestyle-, Religion-, and Health-Related Factors, ($n = 67,781$), the Southern Community Cohort Study, 2002–2009

Variable	No. of Events	All	Symptom Severity						P for interaction ^c
			Mild Depression ^a		Moderate Depression ^a		Severe Depression ^a		
			aHR ^b	95% CI	aHR ^b	95% CI	aHR ^b	95% CI	
Sex									
Female	306	40,912	1.24	0.93, 1.66	1.32	0.95, 1.84	1.56	1.10, 2.20	0.47
Male	517	26,869	1.25	1.02, 1.53	1.31	1.00, 1.71	1.28	0.89, 1.81	
Educational level									
<High school	284	21,710	1.33	1.01, 1.75	1.20	0.85, 1.69	1.01	0.65, 1.58	0.04
≥High school	539	46,071	1.18	0.85, 1.46	1.38	1.06, 1.79	1.68	1.26, 2.26	
Annual income, USD									
<15,000	581	41,614	1.25	1.03, 1.53	1.32	1.04, 1.68	1.37	1.03, 1.81	0.56
≥15,000	242	26,167	1.22	0.89, 1.68	1.29	0.84, 1.97	1.64	0.99, 2.73	
Marital status									
Married or living with partner	207	21,470	1.44	1.03, 2.00	1.29	0.82, 2.02	1.52	0.90, 2.56	0.98
Separated, divorced, or single and never married	616	46,311	1.19	0.98, 1.45	1.32	1.05, 2.67	1.39	1.06, 1.84	
Body mass index, % ^d									
<25.0	313	17,270	1.02	0.77, 1.34	1.07	0.75, 1.51	1.38	0.94, 2.05	0.89
25.0–29.9	270	19,504	1.61	1.21, 3.15	1.74	1.22, 2.48	1.59	1.01, 2.49	
≥30.0	240	31,007	1.22	0.89, 1.67	1.28	0.88, 1.86	1.32	0.85, 2.05	
Regular exercise (metabolic-equivalent hours/week)									
<7.5	604	51,614	1.09	0.89, 1.32	1.14	0.89, 1.45	1.25	0.95, 1.65	<0.001
7.5–31.5	134	10,491	1.41	0.95, 3.14	1.75	1.05, 2.90	1.34	0.61, 2.98	
>31.5	84	5,676	2.63	1.57, 4.40	2.51	1.31, 4.82	4.14	1.98, 8.65	
Alcohol consumption									
Never drinker	278	32,339	1.40	1.05, 1.87	1.26	0.87, 1.83	1.52	1.01, 2.28	0.76
Ever drinker	545	35,442	1.18	0.96, 1.45	1.35	1.05, 1.73	1.38	1.02, 1.88	
Cigarette-smoking status									
Never smoker	144	23,569	1.18	0.79, 1.75	1.23	0.74, 2.06	0.77	0.35, 1.70	0.16
Ever smoker	679	44,212	1.27	1.05, 1.52	1.34	1.07, 1.68	1.54	1.19, 2.00	
Comorbidity index score									
0	172	12,297	1.66	1.17, 2.36	1.56	0.94, 2.56	2.87	1.64, 5.04	0.03
1–2	388	34,438	1.10	0.86, 1.41	1.12	0.82, 1.53	1.30	0.90, 1.87	
≥3	263	21,046	1.19	0.87, 1.61	1.42	1.01, 1.99	1.20	0.20, 1.80	
Attending religious or faith-based services									
Never or occasional	512	34,014	1.30	1.05, 1.61	1.34	1.03, 1.73	1.46	1.09, 1.96	0.64
At least once a week	311	33,767	1.16	0.88, 1.53	1.29	0.91, 1.82	1.43	0.85, 2.10	

Table continues

Second, there may be many potential sources of residual not accounted for in our study. For example, we did not have detailed information on depression treatment and coexisting mental diseases. Also, the influence of unmeasured

confounders cannot be ruled out. Third, although the CESD-10 is widely used and recognized as a well-established instrument for measuring depressive symptoms, the validity of the instrument has not been evaluated in the SCCS, which

Table 5. Continued

Variable	No. of Events	All	Symptom Severity						P for interaction ^c	
			Mild Depression ^a		Moderate Depression ^a		Severe Depression ^a			
			aHR ^b	95% CI	aHR ^b	95% CI	aHR ^b	95% CI		
How much is religion, faith, or God a source of strength and comfort to you?										
Not very much, somewhat, quite a bit	335	20,847	1.15	0.87, 1.05	1.39	1.02, 1.73	1.42	0.99, 2.05		
Great deal	488	46,933	1.32	1.07, 1.64	1.25	0.94, 1.66	1.42	1.02, 1.97	0.68	
Perceived spirituality or religiosity										
Not at all, slightly, fairly spiritual or religious	444	29,846	1.30	1.03, 1.62	1.34	1.01, 1.77	1.47	1.05, 2.04	0.71	
Very spiritual or religious	379	37,935	1.17	0.97, 1.59	1.29	0.95, 1.76	1.39	0.97, 2.00		
Deprivation index										
Less than the median (less deprived)	215	15,569	1.36	0.98, 1.89	1.20	0.79, 1.82	1.23	0.79, 1.82	0.77	
Greater than the median (more deprived)	608	52,212	1.21	1.00, 1.47	1.36	1.07, 1.73	1.51	1.13, 2.01		

Abbreviations: aHR, adjusted hazard ratio; CESD-10, 10-item Center for Epidemiological Studies Depression Scale; CI, confidence interval.

^a CESD-10 score: no depression, <10.0; mild depression, 10.0–14.9; moderate depression, 15.0–19.9; severe depression, ≥ 20.0.

^b Adjusting for age and other variables included in the table.

^c P for interaction refers to P for interaction between depressive symptoms (CESD-10 score, continuous variable) and variables of interest.

^d Weight (kg)/height (m²).

comprises a population of mostly Black and low-income participants. The association we found for mild depression symptoms may have partly resulted from less-than-optimal depression measurements. Last, but not least, although our study is the largest study to date, to our knowledge, in which racial differences were investigated for associations of depression with death and potential modifications by demographic and lifestyle factors, the statistical power of our study may not be great enough to detect 3-way interactions.

In summary, we found that racial differences exist regarding the impact of depressive symptoms on all-cause and CVD-related mortality, with White participants being more vulnerable to the effects of depression in the low-SES population. We also demonstrated that depressive symptoms are associated with increased mortality rates due to external causes, but not with cancer-related death, regardless of race. In addition, our study raises the possibility that certain sociodemographic, lifestyle, and health factors may modify the association of depressive symptoms with death, such as income and comorbidity for CVD-related death, and education, exercise, and comorbidity for external-cause death.

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