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Associations between race and ethnicity and late-life depression severity, symptom burden and care

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Abstract

IMPORTANCE: Knowledge gaps persist regarding racial and ethnic variation in late-life depression, including differences in specific depressive symptoms and disparities in care.

OBJECTIVE: To determine racial/ethnic differences in depression severity, symptom burden and care.

DESIGN, SETTING, PARTICIPANTS: Participants were community-dwelling older adult in the VITamin D and OmegA-3 TriaL, a randomized trial of cancer and cardiovascular disease prevention among 25,871 adults.

EXPOSURE: Racial and ethnic group (Non-Hispanic White, Black, Hispanic, Asian and Other/ Multiple/Unspecified race).

MAIN OUTCOMES AND MEASURES: Depressive symptoms were assessed using the Patient Health Questionnaire-8 (PHQ-8); participants reported diagnosis and medication and/or counseling for depression. Differences across racial/ethnic groups were evaluated using: multivariable zero-inflated negative binomial regression to compare PHQ-8 scores; multivariable

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logistic regression to estimate odds of item-level symptom burden and odds of depression treatment among those with diagnosed depression.

RESULTS: There were 25,503 VITAL participants with adequate depression data (mean [standard deviation] age=67.1 [7.1] years), including: 12888 [50.5%] female, 17828 [69.9%] non-Hispanic White, 5004 [19.6%] Black, 1001 [3.9%] Hispanic, 377 [1.5%] Asian and 1293 [5.1%] Other/Multiple/Unspecified-race participants. After adjustment for sociodemographic, lifestyle and health confounders, compared to non-Hispanic Whites: Black participants had a 10% higher severity level of PHQ-8 scores (RR (rate ratio)=1.10, 95% CI: 1.04-1.17; p<0.001); Hispanic participants had 23% higher severity of PHQ-8 (RR=1.23, 95% CI: 1.10-1.38; p<0.001); Other/Multiple/Unspecified-race participants had 14% higher severity of PHQ-8 (RR=1.14, 95% CI: 1.04-1.25; p=0.007). Minorities had 1.5-2-fold significantly higher adjusted odds of sadness, anhedonia and psychomotor symptoms compared to non-Hispanic Whites; multivariable-adjusted odds of sleep problems and guilt appeared higher among Hispanic vs. non-Hispanic White participants. Among those with clinically significant depressive symptoms (PHQ-8≥10) and/or diagnosed depression, Black compared to non-Hispanic White participants were 61% less likely to report any treatment (medications and/or counseling), after adjusting for confounders.

CONCLUSIONS AND RELEVANCE: In this large cross-sectional study, we observed significant racial and ethnic differences in late-life depression severity, item-level symptom burden, and depression care, after adjustment for numerous confounders. Findings suggest a need for further examination of novel patient- and provider-level factors underlying these associations.

INTRODUCTION

Depression is a leading cause of disability and global disease burden and poses serious consequences for affected individuals and society alike.[1] Late-life depression (LLD) is common. In a recent meta-analysis, estimated current and lifetime prevalence rates of MDD (major depressive disorder) among older adults were 3.3% and 16.5%, respectively; current prevalence of significant late-life depressive symptoms (i.e., encompassing major and minor depression) is higher, at 19%.[2, 3] Yet, even with appropriate diagnosis and treatment, residual symptoms and dysfunction frequently occur in LLD.[4]

Current evidence indicates that older racial/ethnic minorities encounter disparities in both depression burden and care. Race/ethnicity may be conceptualized as a complex multidimensional construct comprising heterogenous societal and cultural factors; thus, in some contexts race/ethnicity may appear as a proxy for social determinants of health.[5] For example, low socio-economic status, low physical activity (PA) and medical comorbidities are established determinants of LLD;[6] as their distributions differ by race/ethnicity,[7] they may contribute to health disparities.[8] Disparities may also include under-diagnosis[9], lower likelihood of receiving depression treatment, and differences in treatment quality.[10–12] Potential disparities[13, 14] are concerning, as the higher current depression burden[15–18], symptom severity[19] and depression-related role dysfunction[20] reported among older minorities may lead to greater adverse long-term health consequences from depression.[21, 22] For example, older minorities bear a disproportionate share of the burden of dementia; it is plausible that a proportion of the variation in dementia risk for older minorities may be explained by LLD and its interplay with prevalent medical comorbidities.[23, 24] Thus, it is

critical to measure the extent of the disparities in symptom severity, burden and care as well as to evaluate potential social, behavioral and health status determinants that may partly underlie disparities.

There is also a need to address potential racial/ethnic variations in presenting symptoms of depression, especially as these may influence how clinicians diagnose or treat LLD. Older adults appear less likely to report certain features of depression, including dysphoria/sadness and guilt, than younger adults.[25] Symptoms such as sleep disturbance, fatigue, loss of interest and hopelessness may be more prominent in LLD.[26] However, knowledge gaps remain regarding racial/ethnic variations in item-level depressive symptoms and overall levels of symptoms among older adults.

Identifying disparities in symptom presentation and treatment of LLD may guide approaches to reducing associated morbidity and mortality. Thus, this project leverages the high-quality depression and other phenotypic data among participants in a large-scale study to evaluate racial/ethnic differences in depression severity, item-level depressive symptom burden, and depression care.

METHODS

Study population

Participants are members of VITAL (VITamin D and OmegA-3 TriaL, NCT01169259) and VITAL-DEP (VITAL-Depression Endpoint Prevention, NCT01696435),[27] a late-life depression ancillary study to VITAL.[28–30] VITAL includes 25,871 men and women, aged 50+ and 55+ years (mean age=67 years), respectively, in a 2×2 factorial randomized trial of cancer and cardiovascular disease prevention using vitamin D and/or fish oil; thus, VITAL and VITAL-DEP participants were free of heart disease or cancer at baseline. Inclusion and exclusion criteria are detailed elsewhere.[27, 30] For this study, we included 25,503 VITAL participants after excluding 368 without adequate depression data (i.e., >2 items missing on the Patient Health Questionnaire-8 (PHQ-8)) (eFigure 1 in the Supplement). Characteristics of included sample participants were comparable to those in the full cohort: e.g. mean age (67.1 years in both groups), female sex (50.6% vs 50.5%), and mean body mass index (BMI) (28.1 kg/m^2 in both groups).

Participant characteristics

Characteristics were self-reported on study questionnaires. Demographic variables include: age (years), sex; race/ethnicity (non-Hispanic White, Black, Hispanic, Asian including Pacific Islander, Others [Native American, Alaskan Native, and other, multiple or unspecified]); education level; yearly income. Lifestyle/behavioral characteristics include: BMI (kg/m^2); PA (total MET (metabolic equivalent)-hours/week); cigarette smoking (current, past or never); alcohol use frequency (never, rarely/monthly, weekly, daily). Medical comorbidity variables included history of hypertension, diabetes and high cholesterol.

Assessment and measures of depression

Depression is characterized in VITAL-DEP by using Boolean classification of depressive symptoms, diagnosis and/or treatment data, consistent with our prior work[31] and other large-scale, high-quality studies of older adults.[32–34] Depressive *symptoms* were ascertained on annual questionnaires via the PHQ-8,[35, 36] which has high validity for identifying clinical depression (e.g., high sensitivity and specificity for MDD at the validated PHQ-8≥10 cut-point)[35, 37] and cross-cultural validity among diverse, community-dwelling older adults.[38–40] *Depression severity* was categorized using total PHQ-8 score (points): no or minimal (0-4), mild (5-9), and moderate or higher (≥10). *Item-level symptom burden* was denoted by report of experiencing the symptom "more than half the days" or "nearly every day" on the PHQ-8. *Depression care* was determined by evaluating self-reported prior and current history of clinician *diagnosis* of depression, use of antidepressant medication, such as selective serotonin reuptake inhibitors (SSRIs), and/or counseling for depression.

Statistical analysis

Demographic, lifestyle, health and depression-related variables were summarized for the whole sample. Characteristics were also compared across racial/ethnic groups. Depression severity was modeled using multilevel zero-inflated negative binomial (ZINB) regression,[41, 42] as this was most appropriate for the distribution of PHQ-8 total score: the mean PHQ-8 score was 1.78 points, while the variance was several-fold larger at 8.51 points, and 46.6% of participants had zero values. The NB portion is clinically interpretable as severity of total symptoms; the ZI portion, which predicts likelihood of all zeroes (0 points) vs. not (≥1 point), is not clinically interpretable in this context due to a lack of meaningful distinction between "true" and "excess" zeroes using the PHQ-8. Thus, we focus interest on the NB portion for addressing total depression severity.

Racial/ethnic differences in item-level depressive symptoms (e.g., anhedonia, sadness, guilt, neuro-vegetative symptoms, etc.) were examined using logistic regression. Of note, Black and Hispanic participants were slightly younger than other racial/ethnic groups (by enrollment design in VITAL, due to race/ethnic differences in age-related risks of heart disease and cancer); thus, we conducted a sensitivity analyses using weighted odds ratios (ORs) to reduce possible bias in the estimates due to the age-and-race structure of the sample.

Finally, we evaluated racial/ethnic differences in depression care when restricting the sample to participants who reported clinically significant depressive symptoms (i.e., PHQ-8≥10).[35] Further, racial/ethnic differences in depression care were analyzed among those who reported *both* PHQ-8≥10 *and* clinician-diagnosed depression. All above-mentioned regression models were sequentially adjusted for demographic factors, and then for lifestyle, medical comorbidity factors, as described above. Statistical analyses were performed with SAS version 9.3 (SAS, Cary, NC). Statistical significance was defined as a two-tailed p-value <0.05. All participants provided written informed consent, and the study was approved by the Institutional Review Board at Brigham and Women's Hospital. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

RESULTS

As shown in Table 1, there were 25,503 participants (mean (SD) age, 67.1 (7.1) years; 12888 (50.5%) females). There were 17828 (69.9%) non-Hispanic Whites, 5004 (19.6%) Blacks, 1001 (3.9%) Hispanics, 377 (1.5%) Asians, and 1293 (5.1%) Others (Other/Multiple/Unspecified race). Participant characteristics are also presented by racial/ethnic groups. As expected, Black and Hispanic participants were younger on average compared to other racial/ethnic groups. Compared to non-Hispanic White participants, Black, Hispanic and Other/Multiple/Unspecified-race participants had lower educational attainment and annual household income, higher BMI, lower daily alcohol consumption, lower current smoking, and lower PA. Prevalence of diabetes was nearly two-fold higher among minorities than non-Hispanic Whites; the disparity in diabetes prevalence among Asians was notable, given lower mean BMI among Asians (24.8 kg/m^2) compared to non-Hispanic Whites (27.4 kg/m^2). Black participants had higher prevalence of hypertension compared to non-Hispanic Whites (67.7% vs. 47.5%).

Racial/ethnic variations were apparent for depression variables. Black, Hispanic and Other/Multiple/Unspecified-race participants were more likely to have PHQ-8≥10 and to endorse core features of depression (i.e., sadness and/or anhedonia for two weeks or longer within the past two years); yet, Black and Hispanic participants were less likely to report SSRI use or having been diagnosed with or treated for depression. Characteristics by depression severity level are also shown (eTable 1 in the supplement). Compared to those with low/mild symptoms, those with moderate or greater symptoms had: lower mean age; higher percentages of females; higher percentages of Black, Hispanic or Other/Multiple/Unspecified-race participants; higher BMI; lower PA; higher current smoking; lower daily alcohol consumption; higher medical comorbidity.

We observed significant differences in depression severity by racial/ethnic group (Table 2). Compared to non-Hispanic White participants, Black, Hispanic and Other/Multiple/Unspecified-race participants had 10%, 23% and 14%, respectively, significantly higher depression severity levels, after adjusting for confounders. Compared to non-Hispanic Whites, Black, Hispanic and Asian, but not Other/Multiple/Unspecified, participants had higher odds of excess zeroes; results of output from the ZINB model, including both the ZI and NB portions, are detailed in eTables 2a and 2b in the supplement. There was no evidence of interactions of race/ethnicity with sex on depression severity – except for Hispanic females, among whom there was a non-statistically significant trend toward higher depression severity compared to Hispanic males (results are not shown here).

We observed significant differences in item-level symptoms across racial/ethnic groups (Table 3). Compared to non-Hispanic Whites, Blacks and Hispanics had 3- to 4-fold higher unadjusted odds of burden from most item-level symptoms, including core features of depression (anhedonia and sadness). Multivariable-adjusted ORs were attenuated to 1.5-2-fold but remained statistically significant for most items, except neuro-vegetative symptoms (e.g., sleep, energy, appetite); higher ORs of burden from sleep problems and guilt remained statistically significant only among Hispanics after adjusting for confounders. We observed statistically significant 2-fold higher odds of anhedonia and concentration difficulty among

Asians compared to non-Hispanic Whites. Among Other/Multiple/Unspecified-race participants, there were 1.5-fold higher multivariable-adjusted odds only of core features (anhedonia and sadness) compared to non-Hispanic Whites. In exploratory analyses addressing possible race/ethnicity-by-sex interactions, we observed borderline trends of 2-fold higher odds of anhedonia and guilt among Hispanic females vs. males (results are not shown here). Finally, in sensitivity analyses using weighted ORs that accounted for racial/ethnic differences in prevalence of age groups in VITAL, we did not observe any differences in the estimates comparing the weighted ORs to those from the primary models (results are not shown here).

Regarding depression care, we observed racial/ethnic differences in diagnosis and treatment use among those who endorsed PHQ-8≥10 (Tables 4 and 5). Due to low numbers of those reporting medication or counseling use in this subset, we combined Hispanic, Asian and Other racial/ethnic groups. Compared to non-Hispanic Whites, Blacks were 61% less likely to report depression treatment (i.e., medications and/or counseling) (adjusted OR=0.39, 95% CI (confidence interval)=0.27-0.56), but no differences were observed for Other racial/ethnic minorities. When we further evaluated differences among those who reported *both* PHQ-8≥10 *and* clinician diagnosis of depression, we observed that Blacks were significantly less likely to report treatment compared to non-Hispanic Whites (adjusted OR=0.42, 95% CI=0.24-0.74). In exploratory stratified analyses, we found suggestions of greater disparity among Black females, although formal tests of race/ethnicity-by-sex interaction were not statistically significant. For example, among participants reporting both PHQ-8≥10 and clinician diagnosis of depression, the adjusted OR of depression treatment was 1.48 (95% CI=0.54-4.01) comparing Black and non-Hispanic White males; by contrast, the adjusted OR of depression treatment was 0.16 (95% CI=0.07-0.36) comparing Black and non-Hispanic White females (results are not shown here).

DISCUSSION

In this large cross-sectional study of a well-characterized and diverse cohort, we utilized novel approaches to evaluate racial/ethnic disparities in late-life depression by examining differences in overall severity of depression symptoms, item-level depressive symptom burden, and depression care. We found significantly higher overall depression severity among Black, Hispanic and Other/Multiple/Unspecified-race participants, compared to non-Hispanic Whites. Item-level symptoms also varied significantly by race/ethnicity. For example, compared to Non-Hispanic Whites: all minorities had higher anhedonia; Blacks and Hispanics had higher anhedonia, sadness and psychomotor symptoms; Asians had higher anhedonia and concentration difficulty. Blacks were especially less likely to receive medication and/or counseling for depression, relative to symptom levels. Finally, there were suggestions of additional variation by sex of observed racial/ethnic disparities: Hispanic females appeared more likely to experience burden from core depressive symptoms and guilt, compared to Hispanic males; Black females were over 80% less likely to report receiving treatment than non-Hispanic White females – even when endorsing *both* clinically significant symptom levels *and* clinician-diagnosed depression.

Our finding that Black older adults had higher overall depression severity is consistent with prior literature.[7, 15, 16, 43] However, examining racial/ethnic disparities in item-level depressive symptoms has been a gap in the evidence to date; thus, the contribution of this study is novel in this regard. Overall, we substantively extend prior findings by examining disparities in both depression severity and item-level symptom burden in a large sample of over 25,000 participants that included Black, Hispanic, Asian, and other minority older adults and had adequate power to address potential further differences by sex.

Observed disparities in depression care among Black participants were also consistent with prior literature. Akincigil et al[44] found that Blacks with clinical diagnoses of depression were 55% less likely to be treated for depression compared to non-Hispanic Whites. Similarly, data from the National Health and Nutrition Examination Survey (NHANES) indicated that, while antidepressant use increased nationally by nearly 65% over a 15-year period (from 7.7% in 1999-2002 to 12.7% in 2011-2014), non-Hispanic Whites were more likely to take antidepressants than Black, Hispanic, and Asians.[45] Thus, our findings suggesting relative under-treatment of depression among older Blacks are consistent with previous studies.[46–48] These disparities are striking given findings that Black older adults appear as likely as Whites to derive benefit from treatment when it is offered. For example, Hall et al[49] found that, given adequate prior antidepressant and psychotherapy exposure, Blacks were no more likely than Whites to discontinue depression treatment. Finally, as noted above, this report includes important preliminary information regarding additional variation by sex of racial/ethnic disparities in depression care.

These findings demonstrate public health significance in several ways. First, we identify significant racial/ethnic disparities in the burden of depression. Given strong evidence that the risk of late-life cognitive impairment and dementia may be amplified by depression,[23, 24, 50] an implication of these racial/ethnic disparities in LLD may include increased risk of late-life cognitive dysfunction among minorities. Second, we observe these depression disparities in the context of other concurrent health disparities (e.g., comorbidities such as diabetes and hypertension) that may be exacerbated by presence of depression. Gallo et al[51] showed that evidence-based treatment of depression in older adults led to a 24% reduction in mortality risk over 8-9-year follow-up, relative to usual care. Thus, an implication of high severity and burden of depression among older minorities, along with lower prevalence of depression care, is that these disparities may not only exacerbate risk of dementia/cognitive impairment and worse health status but also foreshorten life expectancy. Third, we adjusted for a comprehensive set of socio-demographic, lifestyle/behavioral, health and comorbidity factors. While unadjusted estimates of increased risk were attenuated, significant differences remained. Therefore, although important social and health determinants, such as low household income, low PA and higher medical comorbidity, were more prevalent among minority groups, these did not fully account for disparities. Thus, other factors, including novel social determinants, require further evaluation regarding their contributions to LLD disparities; these may include mistrust or bias, experiences of discrimination, stigma related to help-seeking, concerns about antidepressants, patient-physician communication issues, sub-optimal care models or lack of culturally-responsive care.

Strengths of this study are noted. First, the cohort has excellent minority representation (30%). Second, participants were asked questions about comprehensive socio-demographic, lifestyle/behavioral and health factors in a systematic, unbiased manner; furthermore, questionnaire participation rates were high (99%). Also, the PHQ-9 has evidence for criterion validity with respect to gold-standard diagnoses of major and minor depression determined by structured psychiatric interviews, and high (r>0.99) correlations between PHQ-8 and PHQ-9 have been demonstrated.[52,53, 54] Third, we addressed racial/ethnic differences in LLD on multiple levels – total severity of symptoms, item-level burden of depressive features, and care variables. To our knowledge, prior studies have not measured *racial and ethnic disparities at the individual item-level of symptoms* in LLD. Finally, we explored whether racial/ethnic differences in depression severity, symptom burden and care further varied by sex.

Limitations

We acknowledge limitations. First, the study is cross-sectional; a longitudinal approach would provide further clarity regarding racial/ethnic differences in LLD outcomes. Second, self-reported race/ethnicity may signal differences in some social, cultural and economic factors that were not explicitly measured in this study; thus, findings of racial/ethnic differences can be cautiously interpreted in this context. Third, VITAL included Black and Hispanic participants who were slightly younger on average than other participants; however, point estimates of weighted ORs were nearly identical to the primary results. Fourth, we did not collect information on suicidal ideation, discrimination, cultural stress, mental health stigma, affordability of services, and other relevant psychosocial factors; thus, we could not address the full breadth of potential psychosocial and cultural drivers of disparities in LLD. Fifth, although prior publications have reported cross-cultural validity of the PHQ-8 among diverse populations, we cannot exclude the possibility of bias in participants' interpretation of the meaning of item-level symptoms; we also cannot clinically interpret differences by race/ethnicity and model covariates in likelihood of "excess zeroes" on the PHQ-8, due to the lack of a clear clinical meaning of the ZI portion of the ZINB model. Finally, participants were members of a long-term randomized trial cohort and, thus, may be healthier or more knowledgeable about health than older adults in the general community. However, such a difference would be likely to render estimates more conservative; also, while this issue may affect generalizability, it does not detract from internal validity of the findings.

Conclusions

We observed higher severity of depression among older minority adults, especially Black and Hispanic participants, in this large cross-sectional study. Furthermore, there was racial/ethnic variation in the burden of item-level depressive symptoms, such as anhedonia, sadness, guilt, concentration and psychomotor symptoms. There was also strong evidence of racial/ethnic disparities in antidepressant and counseling treatment among depressed older adults – particularly affecting older Black women with depression. Future work in a longitudinal setting can clarify how the racial/ethnic differences observed in this study regarding late-life depression severity, symptom burden and care may evolve over time.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Question:

Do older adults from minority racial and ethnic groups differ from non-Hispanic White older adults regarding severity of depression, item-level depressive symptoms and depression care?

Findings:

The cross-sectional study of 25,503 participants found significant racial/ethnic disparities, with higher overall severity of depression scores, 1.5-2-fold higher odds of several item-level depressive symptoms and lower prevalence of depression care among minorities, after adjusting for confounders.

Meaning:

Observed racial and ethnic disparities among older adults in late-life depression severity, symptomatology and treatment suggest the need for further examination of a broad range of patient- and provider-level factors that may drive these associations.

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Table 1.

Baseline demographic, lifestyle/behavioral, health and depression characteristics of the sample by race/ethnic groups *

Baseline Characteristics	Total cohort[a] (n=25503)	Race/ethnicity				
		Non-Hispanic White (n=17828)	Black (n=5004)	Hispanic (n=1001)	Asian[b] (n=377)	Other/Multi/ Unspecified[c] (n=1293)
Demographic						
Mean age (SD), in years	67.1 (7.1)	68.1 (6.8)	63.3 (6.8)	67.3 (6.6)	67.6 (6.7)	68.3 (7.3)
Sex, %	25503 / 100.0					
Male	49.5	51.9	38.1	63.9	58.6	45.9
Female	50.5	48.1	61.9	36.1	41.4	54.1
Education, (%)	25450 / 99.8					
Did not complete high school	1.4	0.5	3.5	4.9	0.3	3.3
High school diploma or GED	11.4	7.7	21.2	19.5	4.8	19.4
Attended or graduated from college	42.0	40.7	48.1	38.0	39.8	40.9
Post-college	45.3	51.2	27.2	37.7	55.2	36.5
Income, %	22993 / 90.2					
< $15,000	6.3	3.1	16.2	8.5	4.5	10.3
$15,000 - 29,999	12.5	9.4	21.6	18.1	8.3	16.5
$30,000 - 49,999	17.7	16.8	20.7	18.1	15.1	19.2
$50,000 - 69,999	16.4	16.7	16.1	14.8	14.8	15.0
$70,000 - 89,999	12.7	13.9	9.0	11.9	11.9	11.0
$90,000 - 120,000	16.3	18.3	9.7	14.4	22.6	13.8
Over $120,000	18.2	21.8	6.8	14.1	22.9	14.2
Lifestyle/behavioral factors						
Mean BMI (SD), kg/m^2	28.1 (5.7)	27.4 (5.2)	30.6 (6.7)	28.7 (5.6)	24.8 (4.2)	28.5 (5.8)
Leisure-time physical activity and stair climbing, total METhours/week, median (interquartile range)[d]	15.5 (27.1)	17.4 (27.2)	9.2 (23.0)	14.5 (28.8)	16.9 (28.5)	13.2 (26.4)
Cigarette smoking, %	25276 / 99.1					
Never	51.7	51.8	50.8	52.8	65.2	49.8
Past	41.1	43.0	34.9	40.6	31.5	41.3

Baseline Characteristics	Total cohort[a] (n=25503)	Race/ethnicity				
		Non-Hispanic White (n=17828)	Black (n=5004)	Hispanic (n=1001)	Asian[b] (n=377)	Other/Multi/ Unspecified[c] (n=1293)
Current	7.2	5.2	14.3	6.6	3.2	8.8
Alcohol use, %	25093 / 98.4					
Never	31.4	26.7	46.0	31.1	43.3	37.4
Rarely-<weekly	7.5	6.8	9.3	8.9	8.3	8.7
1-6 /week	35.0	35.8	32.5	38.5	35.3	31.3
Daily	26.1	30.7	12.3	21.6	13.2	22.6
Comorbidity factors						
Hypertension[e], (%)	25336 / 99.5					
Yes	51.8	47.5	67.7	51.2	49.9	51.4
No	48.2	52.5	32.3	48.8	50.1	48.6
Diabetes[f], (%)	25462 / 99.8					
Yes	13.7	10.4	23.9	20.0	21.0	13.6
No	86.3	89.6	76.2	80.0	79.1	86.4
High Cholesterol, %	25219 / 98.9					
Yes	37.5	39.1	32.0	37.1	42.9	35.7
No	62.5	60.9	68.0	62.9	57.1	64.3
Depression Characteristics						
Median PHQ-8 score (IQR)	1.0 (2.0)	1.0 (2.0)	1.0 (3.0)	1.0 (3.0)	0.0 (2.0)	1.0 (3.0)
PHQ-8 severity, %	25503 / 100.0					
None (0 points)	46.6	47.5	43.6	48.3	54.1	42.9
Minimal (1-4 points)	41.8	42.9	39.0	37.1	36.9	43.4
Mild (5-9 points)	8.6	7.6	11.7	9.6	6.9	9.5
Moderate (10-14 points)	2.0	1.4	3.7	2.9	1.6	3.2
Moderate-severe (15-19 points)	0.7	0.4	1.5	1.9	0.3	0.6
Severe (20+ points)	0.3	0.2	0.6	0.3	0.3	0.5
SSRI use, %	25140 / 98.6					
Yes	6.4	7.2	3.8	5.0	2.2	6.8

Baseline Characteristics	Total cohort[a] (n=25503)	Race/ethnicity				
		Non-Hispanic White (n=17828)	Black (n=5004)	Hispanic (n=1001)	Asian[b] (n=377)	Other/Multi/ Unspecified[c] (n=1293)
No	93.6	92.8	96.2	95.0	97.8	93.2
Ever diagnosed with/ took medication for/ counseled for depression, %	23425 / 91.9					
Yes	20.7	21.4	19.1	17.5	8.6	23.3
No	79.3	78.6	81.0	82.5	91.4	76.7
→If ever diagnosed: took medication or received counseling in the past 2 yrs, %	4784 / 98.7					
Yes	54.9	54.8	51.1	62.3	58.6	62.9
No	45.1	45.2	48.9	37.7	41.4	37.1
Felt sad/depressed for 2+ weeks in the last 2 yrs, %	25389 / 99.6					
Yes	12.3	10.8	16.7	14.3	10.6	15.6
No	87.7	89.2	83.3	85.7	89.4	84.4

Abbreviations: GED – General Education Diploma; BMI – Body Mass Index; PHQ-8 – Patient Health Questionnnaire-8; SSRI – Selective serotonin reuptake inhibitor; SD – Standard Deviation; IQR – Inter-Quartile Range

[*] Figures for percentages may not add to 100.0 due to rounding.

[a] For categorical variables, this column contains number of participants in the category / % of non-missing responses. For continuous variables, this column contains the mean (standard deviation (SD)) or the median (interquartile range);for categorical variables, the frequency percentages for non-missing responses are presented. The prevalence of missing responses for all variables ranged from 0 to <5%, except for the following: income (~10% missing), ever diagnosed with / took medication for / counseled for depression (~8% missing).

[b] Asian group also includes Pacific Islanders.

[c] Other race/ethnicity includes Native American/American Indians, Native Hawaiians, and other or multiple or unspecified race/ethnicity.

[d] Leisure-time physical activities: walking or hiking; jogging; running; bicycling; aerobic exercise/aerobic dance/exercise machines; lower intensity exercise/yoga/stretching/toning; tennis/squash/ racquetball; lap swimming; weight lifting/strength training; other exercise

[e] Hypertension: Ever diagnosed with high blood pressure or ever use of anti-hypertensive medication

[f] Diabetes: Ever diagnosed with diabetes or current use of anti-diabetic medication

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Table 2.

Differences in depression severity, by race/ethnicity

Regression Models (n=25,503)[a]	Race/ethnicity								
	Non-Hispanic White[b] (n=17828)	Black (n=5004)		Hispanic (n=1001)		Asian[c] (n=377)		Others[d] (n=1293)	
	RR (95% CI)	RR (95% CI)	P Value	RR (95% CI)	P Value	RR (95% CI)	P Value	RR (95% CI)	P Value
Model 1[e]	1.00 (Ref)	1.64 (1.54 - 1.73)	<0.001	1.51 (1.34 - 1.71)	<0.001	1.12 (0.90 - 1.38)	0.32	1.32 (1.19 - 1.47)	<0.001
Model 2[f]	1.00 (Ref)	1.23 (1.16 - 1.30)	<0.001	1.28 (1.14 - 1.43)	<0.001	1.10 (0.90 - 1.33)	0.36	1.15 (1.04 - 1.26)	0.005
Model 3[g,i]	1.00 (Ref)	1.13 (1.07 - 1.20)	<0.001	1.24 (1.11 - 1.39)	<0.001	1.16 (0.95 - 1.40)	0.14	1.12 (1.02 - 1.23)	0.02
Model 4[h,i]	1.00 (Ref)	1.10 (1.04 - 1.17)	<0.001	1.23 (1.10 - 1.38)	<0.001	1.10 (0.91 - 1.33)	0.34	1.14 (1.04 - 1.25)	0.007

Abbreviations: RR – Rate Ratio; CI – Confidence Interval; PHQ-8 – Patient Health Questionnaire-8

[a]Results from the negative binomial (NB) portion of zero-inflated negative binomial (ZINB) regression show Rate Ratios (RRs) and 95% confidence intervals (CIs), which reflect percent differences in total depression severity on the PHQ-8 among minority racial groups. See eTables 2a and 2b in the supplement for extended results of output from ZI and NB portions.

[b]Non-Hispanic White participants are the reference group.

[c]Pacific Islanders were included in Asians

[d]Other race/ethnicity includes Native Americans/American Indians, Native Hawaiian, other, multiple, unknown and unspecified race/ethnicity.

[e]Model 1 was analyzed as a univariate model,

[f]Model 2 was adjusted for demographic factors.

[g]Model 3 adjusted for demographic and lifestyle/behavioral factors,

[h]Model 4 adjusted for demographic, lifestyle/behavioral and comorbidity factors.

[i]To avoid undefined physical activity estimates in missing indicator, we imputed median value for the participants who were missing information on physical activity.

Table 3.

Associations of race/ethnicity with odds of elevated item-level depressive symptom burden

Item-level symptoms	Odds ratio (95% confidence interval)				
	Non-Hispanic White[a] (n=17828)	Black (n=5004)	Hispanic (n=1001)	Asian[b] (n=377)	Others[c] (n=1293)
Anhedonia					
Model 1[d]	1.00 (Ref)	3.71 (3.17 - 4.34)	2.83 (2.09 - 3.84)	2.07 (1.20 - 3.57)	2.12 (1.56 - 2.88)
Model 2[e]	1.00 (Ref)	2.12 (1.77 - 2.53)	2.03 (1.48 - 2.77)	2.13 (1.23 - 3.68)	1.59 (1.16 - 2.17)
Model 3[f,h]	1.00 (Ref)	1.81 (1.51 - 2.17)	1.99 (1.45 - 2.72)	2.24 (1.29 - 3.90)	1.47 (1.07 - 2.01)
Model 4[g,h]	1.00 (Ref)	1.76 (1.47 - 2.11)	1.96 (1.43 - 2.69)	2.14 (1.23 - 3.74)	1.47 (1.07 - 2.02)
Sadness					
Model 1[d]	1.00 (Ref)	3.03 (2.55 - 3.59)	3.03 (2.23 - 4.13)	1.27 (0.63 - 2.59)	2.11 (1.54 - 2.91)
Model 2[e]	1.00 (Ref)	1.57 (1.29 - 1.91)	2.15 (1.56 - 2.96)	1.29 (0.63 - 2.63)	1.58 (1.14 - 2.19)
Model 3[f,h]	1.00 (Ref)	1.36 (1.12 - 1.66)	2.13 (1.55 - 2.94)	1.32 (0.64 - 2.71)	1.46 (1.05 - 2.03)
Model 4[g,h]	1.00 (Ref)	1.31 (1.07 - 1.60)	2.09 (1.51 - 2.88)	1.25 (0.61 - 2.57)	1.46 (1.05 - 2.03)
Sleep					
Model 1[d]	1.00 (Ref)	1.57 (1.42 - 1.73)	1.44 (1.18 - 1.76)	0.77 (0.51 - 1.16)	1.28 (1.06 - 1.54)
Model 2[e]	1.00 (Ref)	1.13 (1.01 - 1.26)	1.27 (1.03 - 1.55)	0.80 (0.53 - 1.21)	1.09 (0.90 - 1.31)
Model 3[f,h]	1.00 (Ref)	1.03 (0.92 - 1.15)	1.26 (1.03 - 1.54)	0.88 (0.58 - 1.32)	1.05 (0.87 - 1.26)
Model 4[g,h]	1.00 (Ref)	0.97 (0.87 - 1.09)	1.24 (1.01 - 1.52)	0.82 (0.54 - 1.24)	1.05 (0.87 - 1.26)
Energy					
Model 1[d]	1.00 (Ref)	2.13 (1.91 - 2.38)	1.47 (1.15 - 1.87)	1.14 (0.75 - 1.75)	1.69 (1.38 - 2.08)
Model 2[e]	1.00 (Ref)	1.25 (1.11 - 1.42)	1.13 (0.88 - 1.46)	1.21 (0.79 - 1.86)	1.29 (1.05 - 1.60)
Model 3[f,h]	1.00 (Ref)	1.03 (0.90 - 1.17)	1.09 (0.85 - 1.41)	1.33 (0.86 - 2.06)	1.19 (0.96 - 1.47)
Model 4[g,h]	1.00 (Ref)	0.96 (0.84 - 1.09)	1.06 (0.83 - 1.37)	1.25 (0.80 - 1.93)	1.18 (0.96 - 1.47)
Appetite					

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Item-level symptoms	Odds ratio (95% confidence interval)				
	Non-Hispanic White[a] (n=17828)	Black (n=5004)	Hispanic (n=1001)	Asian[b] (n=377)	Others[c] (n=1293)
Model 1[d]	1.00 (Ref)	2.24 (1.96 - 2.57)	1.64 (1.23 - 2.19)	0.80 (0.42 - 1.51)	1.63 (1.26 - 2.11)
Model 2[e]	1.00 (Ref)	1.27 (1.09 - 1.48)	1.35 (1.00 - 1.81)	0.86 (0.45 - 1.62)	1.26 (0.97 - 1.64)
Model 3[f,h]	1.00 (Ref)	1.03 (0.88 - 1.20)	1.31 (0.97 - 1.77)	0.99 (0.52 - 1.89)	1.15 (0.88 - 1.51)
Model 4[g,h]	1.00 (Ref)	0.97 (0.83 - 1.14)	1.28 (0.95 - 1.73)	0.93 (0.49 - 1.78)	1.15 (0.88 - 1.51)
Guilt					
Model 1[d]	1.00 (Ref)	3.01 (2.54 - 3.58)	2.62 (1.89 - 3.63)	1.27 (0.63 - 2.59)	1.87 (1.34 - 2.62)
Model 2[e]	1.00 (Ref)	1.40 (1.15 - 1.70)	1.83 (1.31 - 2.57)	1.29 (0.63 - 2.63)	1.40 (0.99 - 1.97)
Model 3[f,h]	1.00 (Ref)	1.26 (1.03 - 1.53)	1.86 (1.33 - 2.61)	1.41 (0.69 - 2.90)	1.32 (0.94 - 1.87)
Model 4[g,h]	1.00 (Ref)	1.20 (0.98 - 1.46)	1.84 (1.31 - 2.59)	1.36 (0.66 - 2.80)	1.32 (0.93 - 1.86)
Concentration					
Model 1[d]	1.00 (Ref)	3.40 (2.80 - 4.13)	1.98 (1.29 - 3.04)	2.20 (1.16 - 4.18)	1.79 (1.20 - 2.67)
Model 2[e]	1.00 (Ref)	1.65 (1.32 - 2.06)	1.28 (0.83 - 1.99)	2.27 (1.19 - 4.33)	1.28 (0.85 - 1.91)
Model 3[f,h]	1.00 (Ref)	1.49 (1.20 - 1.87)	1.30 (0.83 - 2.01)	2.38 (1.24 - 4.56)	1.20 (0.80 - 1.80)
Model 4[g,h]	1.00 (Ref)	1.42 (1.13 - 1.78)	1.27 (0.82 - 1.97)	2.26 (1.18 - 4.33)	1.19 (0.79 - 1.80)
Motor					
Model 1[d]	1.00 (Ref)	3.86 (2.98 - 5.00)	3.06 (1.87 - 4.99)	1.27 (0.40 - 4.01)	2.36 (1.45 - 3.85)
Model 2[e]	1.00 (Ref)	2.12 (1.58 - 2.84)	2.12 (1.29 - 3.51)	1.32 (0.42 - 4.19)	1.70 (1.03 - 2.80)
Model 3[f,h]	1.00 (Ref)	1.85 (1.38 - 2.49)	2.12 (1.28 - 3.50)	1.29 (0.41 - 4.11)	1.57 (0.95 - 2.59)
Model 4[g,h]	1.00 (Ref)	1.77 (1.31 - 2.39)	2.12 (1.28 - 3.50)	1.27 (0.40 - 4.05)	1.56 (0.95 - 2.58)

[a]Non-Hispanic White participants were the reference group.

[b]Pacific Islanders were included among Asians

[c]Other race/ethnicity includes Native Americans/American Indians, Native Hawaiians, and other, multiple or unspecified race/ethnicity.

[d]Model 1 was analyzed as a univariate model,

[e] Model 2 was adjusted for demographic factors.

[f] Model 3 adjusted for demographic and lifestyle/behavioral factors,

[g] Model 4 adjusted for demographic, lifestyle/behavioral and comorbidity factors.

[h] To avoid undefined physical activity estimates when using a missing indicator for physical activity, we imputed the median value for the small percentage (<1%) of participants who were missing information on physical activity.

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Table 4.

Association of race/ethnicity with odds of antidepressant medication use, among those reporting clinically significant depressive symptoms (PHQ-8 ≥ 10)

Outcome (n=755)	Odds ratio (95% confidence interval)		
	Non-Hispanic White[a] (n=354)	Black (n=287)	Hispanic, Asian and Other race/ethnicity (n=114)
Medication / Counseling Use[b]			
Model 1[c]	1.00 (Ref)	0.53 (0.39-0.72)	1.05 (0.68-1.61)
Model 2[d,g]	1.00 (Ref)	0.40 (0.28-0.57)	1.10 (0.70-1.73)
Model 3[e,g]	1.00 (Ref)	0.39 (0.27-0.56)	1.12 (0.71-1.76)
Model 4[f,g]	1.00 (Ref)	0.39 (0.27-0.56)	1.10 (0.69-1.74)

Abbreviations: PHQ-8 – Patient Health Questionnaire-8

[a] Non-Hispanic White participants were the reference group.

[b] Medication / counseling use was determined based on self-reported use of selective serotonin reuptake inhibitors (SSRIs) or other medications for depression and/or counseling for depression.

[c] Model 1 was analyzed as a univariate model,

[d] Model 2 was adjusted for demographic factors.

[e] Model 3 adjusted for demographic and lifestyle/behavioral factors,

[f] Model 4 adjusted for demographic, lifestyle/behavioral and comorbidity factors.

[g] In this small sample size analysis, to avoid quasi-separation issues / undefined estimates in the adjusted models, we imputed the mean value to missing body mass index, the median value to physical activity, and the largest education category to those missing education information. We combined some categories to create binary variables: smoking use (ever/never smoker) and alcohol frequency use (daily vs. non-daily use). For comorbidity variables such as history of hypertension, diabetes and high cholesterol: missing participants were combined to reference (‘no’) categories.

Table 5.

Association of race/ethnicity with antidepressant medication use, among those reporting clinically significant depressive symptoms (PHQ-8 ≥ 10) as well as clinician diagnosis of depression

Outcome (n=466)	Odds ratio (95% confidence interval)		
	Non-Hispanic White[a] (n=232)	Black (n=165)	Hispanic, Asian and Other race/ethnicity (n=69)
Medication / Counseling Use[b]			
Model 1[c]	1.00 (Ref)	0.56 (0.35-0.89)	1.47 (0.68-3.20)
Model 2[d,g]	1.00 (Ref)	0.44 (0.26-0.74)	1.33 (0.60-2.96)
Model 3[e,g]	1.00 (Ref)	0.38 (0.22-0.66)	1.31 (0.58-2.97)
Model 4[f,g]	1.00 (Ref)	0.42 (0.24-0.74)	1.34 (0.59-3.05)

Abbreviations: PHQ-8 - Patient Health Questionnaire-8

[a]Non-Hispanic White participants were the reference group.

[b]Medication / counseling use was determined based on self-reported use of selective serotonin reuptake inhibitors (SSRIs) or other medications for depression and/or counseling for depression.

[c]Model 1 was analyzed as a univariate model,

[d]Model 2 was adjusted for demographic factors.

[e]Model 3 adjusted for demographic and lifestyle/behavioral factors,

[f]Model 4 adjusted for demographic, lifestyle/behavioral and comorbidity factors.

[g]In this small sample size analysis, to avoid quasi-separation issues / undefined estimates in the adjusted models, we imputed the mean value to missing body mass index, the median value to physical activity, and the largest education category to those missing education information. We combined some categories to create binary variables: smoking use (ever/never smoker) and alcohol frequency use (daily vs. non-daily use). For comorbidity variables such as history of hypertension, diabetes and high cholesterol: missing participants were combined to reference (‘no’) categories.