# RACIAL/ETHNIC DIFFERENCES IN HYPERTENSION AND DEPRESSION AMONG US ADULT WOMEN

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**Objectives:** This study assesses racial/ethnic differences in the odds of hypertension among US adult women and examines the degree to which depression, in addition to demographic, socioeconomic status, and health lifestyle characteristics, account for observed differences.

**Methods:** The most recent iterations of the National Health Interview Survey (2001–2003) were used to examine the odds of hypertension among adult women aged ≥18. The sample consisted of non-Hispanic Whites ($n$=34,698), non-Hispanic Blacks ($n$=8,077), and Hispanics ($n$=9,055).

**Results:** Age-adjusted hypertension rates were significantly higher for Black and Hispanic women than for White women. Sequential logistic regression models demonstrated that health lifestyle accounted for the largest portion of the racial/ethnic gap in hypertension, and depression had little mediating influence. Adjusting for all covariates reduced the gap between Black and White women somewhat, but Black women retained their elevated odds of hypertension (odds ratio [OR] 1.74, 95% confidence interval [CI] 1.60–1.90), while the gap between Hispanic and White women was reduced to nonsignificance (OR .99, 95% CI .90–1.11). Interaction tests revealed that the relationship between depression and hypertension differed across racial/ethnic groups; depression had a much stronger association with hypertension among Black and Hispanic women than among Whites.

**Conclusions:** After adjusting for age, Black and Hispanic women were more hypertensive than their White counterparts, and depression disproportionately increased their risk. Efforts to improve hypertension treatment and control would benefit from a better understanding of the link between mental and physical health among US minority groups. (*Ethn Dis*. 2007;17:389–396)

**Key Words:** Depression, Hypertension, Race/Ethnicity, Women

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Cardiovascular disease (CVD) mortality is the leading cause of death among US women and truncates the lives of Black women at a higher rate than those of White or Hispanic women.[1,2] Although rates for heart disease mortality have declined for all US racial/ethnic groups, they have done so at a far slower pace for Blacks than for Whites, resulting in a widening of the racial gap in cardiovascular disease.[3] Hypertension is a powerful independent risk factor for cardiovascular disease, and its prevalence is significantly higher among Blacks than Whites,[4] higher among Black than White men,[5] and highest among Black women.[6–7] In 2002, for example, the age-adjusted rates for hypertension among women ≥20 years were nearly twice as high for Black women (39.4%) than for White or Hispanic women (23.3% and 23.4%, respectively).[8]

Although a wealth of studies have been conducted on the prevalence, trends, risks, and treatment of hypertension, very few assess differences separately by sex or by racial/ethnic group, and even fewer examine differences between racial/ethnic groups of men or women.[9–13] One reason for a lack of such studies is that most data on hypertension derive from clinical trials or population health surveys that contain too few racial/ethnic minorities to sustain a stratified analysis of health outcomes separately by sex. Moreover, whether and how known risk factors for hypertension, such as health lifestyle and depression, contribute to observed disparities between racial/ethnic groups of women remains poorly understood.

Depression is an important risk factor to consider because of its direct and indirect relationship to cardiovascular disease. Depression has a direct effect on coronary heart disease via increased adrenergic activity that can have a pressor effect on the cardiovascular system.[14] Indirectly, recent longitudinal studies demonstrate a strong association between depression and hypertension (and thus CVD): persons with depression are more likely to develop hypertension over time, even after adjustment for other hypertension risk factors, including age, family history of hypertension, education, race, sex, body mass index (BMI), exercise, smoking, and alcohol use.[15–18] While hypertension may lead to depression, research to date finds greater evidence that depression leads to physical health problems.[19] For example, Davidson and colleagues found that depressive symptoms in young adults were predictive of later hypertension incidence, and this finding was especially true for young Blacks.[16] Similarly, Jonas and colleagues found that depression significantly increased the risk for hypertension in adult men and women, especially Blacks, even after controlling for other known risk factors, such as age, sex, education, cigarette smoking, BMI, alcohol use, history of diabetes, stroke, or coronary heart disease, and baseline systolic blood pressure.[17]

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Depression should also be considered as a mediating mechanism in assessments of women's physical health because depression rates are significantly higher among women than men.[20–23] Regardless of how depression is mea-

sured (major depression, chronic minor depression, or depressed mood), Kessler concludes in his review of female depression that women are 1.5–3 times more likely to suffer from depression than men.[24] While the racial and ethnic pattern in depression is not entirely clear, it does appear that Blacks have a higher rate of depressive symptoms than do Whites, while rates for Hispanics are more similar to those of Whites.[25–27] Overall, these findings suggest that depression may help explain racial and ethnic disparities in hypertension rates among adult women.

Given the research reviewed above, the primary aim of this study is to examine the role of depression in contributing to racial/ethnic disparities in hypertension among adult women. To that end, we explore the role of depression as a mediating mechanism that helps explain racial disparities in hypertension prevalence. We also examine whether racial/ethnic group membership has a moderating influence on the effect of depression, wherein the detrimental influence of depression on hypertension is stronger in certain racial/ethnic groups than others (Figure 1). By examining whether and how depression contributes to racial/ethnic disparities in hypertension, this study hopes to contribute to research that will lead to interventions that alter the morbidity and mortality profiles of adult women.

## METHODS

### Study Population

This research uses data drawn from the 2001, 2002, and 2003 waves of the National Health Interview Survey (NHIS), an annual, multipurpose health survey conducted by the National Center for Health Statistics and the Centers for Disease Control and Prevention and administered by the US Census Bureau. The NHIS uses a multistage, stratified, cluster design and includes an oversample of Black and Hispanic populations. The US Census Bureau conducts face-to-face interviews, collecting information about health and other characteristics of each member of the household. When weighted, the data are nationally representative of the noninstitutionalized civilian population in the United States.[28]

For each family in the NHIS, one sample adult (aged ≥18 years) was randomly selected and included in the sample adult core. Respondents included in the adult sample core are queried on a detailed set of questions regarding health status, healthcare services, and behavior. To ensure that we used the most recent data available from the NHIS, and to ensure a large enough sample of Black and Hispanic women, we analyzed data from the 2001–2003 waves of the sample adult survey ($n$=95,222). We then limited the sample to women who had non-missing information on hypertension and who identified themselves as non-Hispanic Black, non-Hispanic White, or Hispanic ($n$=51,830).

### Measures

The NHIS survey asks a series of questions regarding chronic medical conditions, including hypertension. Specifically, respondents were asked, "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" Responses are coded 1 for yes and 0 for no. In addition to identifying the extent of racial/ethnic differences in hypertension among adult women, we also attempted to explain these differences by adjusting for covariates in our multivariate logistic regression models.

Our main independent measure of interest was depressive mood, which was gauged via the averaged response to six questions that asked, during the last 30 days, how often the respondent felt sad, hopeless, restless, nervous, worthless, and that everything was an effort ($\alpha$=.87). Responses were 1=none of the time, 2=a little of the time, 3=some of the time, 4=most of the time, and 5=all of the time. This index was constructed from questions drawn from item response theory models and was validated with a two-stage clinical reappraisal survey.[29]

Our control measures were grouped into three categories. First, we controlled for numerous demographic characteristics known to be associated with hypertension, including age, family size, marital status, and whether the respondent was born in the United States. Second, we included detailed measures of socioeconomic status, including education level, family income-to-poverty ratio, employment status, health insurance status, and how long it had been since the respondent last saw a doctor. We also constructed a dichotomous measure of whether the respondent reported any financial barriers to medical care (1=yes, 0=no), created from three questions that asked whether, during the last 12 months, the respondent had delayed medical care, did not receive medical care, or did not receive prescribed medications because they could not afford it (scale reliability: $\alpha$=.75).

Third, we included several measures of health lifestyle, including smoking, alcohol use, BMI, and whether the respondent has been diagnosed with diabetes. We also constructed a measure of the frequency of participation in physical activity, which is based on the averaged response to three questions which asked about participation in: 1) light or moderate activities for ≥10 minutes that cause only light sweating or a slight-to-moderate increase in breathing or heart rate; 2) vigorous activities for ≥10 minutes that cause heavy sweating or a large increase in breathing or heart rate; and 3) activities designed to strengthen muscles, such as lifting weights. Responses ranged from 1=never, 2=less than once a week, 3=1–2 times, 4=3–4 times,

and 5=≥5 times per week (scale reliability: $\alpha$ =.66).

## Data Analysis

Our expectations for our analyses are the following. First, given what we know about race, ethnicity, and hypertension, we expect that hypertension rates will be much higher among Black women than among White or Hispanic women. Second, prior research on the association between race, depression, and hypertension leads us to expect that depression will mediate some of the relationship between race/ethnicity and hypertension. Further, the strong disparities in demographic, socioeconomic, and health characteristics between White, Black, and Hispanic women suggests that race/ethnicity may moderate the association between depression and hypertension, wherein depression is the least detrimental for White (and perhaps Hispanic) women and the most detrimental for Black women.

We organized our analysis into three sections. We begin by presenting rates of hypertension and depressive mood separately by racial and ethnic group, followed by descriptive statistics that summarize the demographic, socioeconomic, and health characteristics of each group of women. Second, our multivariate analysis includes a set of logistic regression models that examine the odds of hypertension for women, and whether they differ by race/ethnic group, net of controls for demographic and socioeconomic characteristics, health lifestyle, and depression. Third, we test whether the effect of depression on hypertension differs by racial and ethnic group, and graphically present the results of this interaction in Figure 1. Taken together, these findings permit us to assess the extent to which racial/ethnic disparities in hypertension among adult women are influenced by depressive mood and other background characteristics.

All analyses are weighted, since Blacks and Hispanics were oversampled during the interview process. Specifically, we applied the final sample adult weight (which includes design, nonresponse, and poststratification adjustments to sample adults), adjusted for the number of survey years (three) included in our sample. In addition, because of the complex sampling strategy employed to collect the NHIS data, all results are estimated with STATA SVY procedures (SVYMEAN for hypertension prevalence and descriptive statistics for other sample characteristics; SVYLOGIT for logistic regression models predicting hypertension diagnosis). Rather than assuming that observations are independent, STATA corrects for the intracluster correlation that occurs because of the complex sample design, producing standard errors that are more accurate and reducing the chance of false-positive significance tests. Furthermore, since hypertension rates increase significantly between 2001 and 2003, we control for survey year in all logistic regression models (not shown).

Missing values on independent measures were imputed with the IMPUTE command in STATA.[30] For imputed measures, most had a low rate of missing values (between .04%–2.64% for nativity, education, employment, barriers to medical care, insurance, doctor's visits, smoking, alcohol use, exercise, diabetes, and depression), and 6.23% of cases were imputed for BMI. For the family income-to-poverty ratio, however, nonresponse was quite high (25.59% of cases), and we included a dummy variable that flags missing cases in the regression models (not shown).

# RESULTS

Table 1 provides the baseline characteristics for the study population separately by race/ethnicity and illustrates the degree to which White, Black, and Hispanic women aged ≥18 years differ statistically from each other on each of the measures (*P* values from two-tailed *t* tests). As seen in Table 1, Black women are significantly more likely than White women to have ever been diagnosed with hypertension (33.7% compared to 25.0%, respectively), while Hispanic women have significantly lower rates of hypertension, at 19.5%. However, given that White women in our sample are more than seven years older, on average, than Hispanic women, this finding may be depressing the hypertension rate for Hispanic women as shown in Table 1, and thus we adjust for age in all regression models (presented below). White women also report significantly less depression than Black and Hispanic women, although rates for Black and Hispanic women are equivalent.

Looking at the other measures presented in Table 1, we find that compared to White women, Black women have lower levels of income and educational attainment, higher rates of unemployment and uninsurance, more financial barriers to medical care, higher BMIs and diabetes, and lower levels of physical activity ($P<.05$ or better for each measure), all of which may contribute to their higher rate of hypertension. Hispanic women also appear disadvantaged on many of these characteristics despite having much lower rates of hypertension than Black women, a finding that may reflect the high proportion of immigrants in the population (61.1%), many of whom have health profiles that fit the "Hispanic paradox" (ie, they have better health than would be predicted given their socioeconomic and demographic profiles).[31] The multivariate regression analyses provide insight into these patterns by examining the effects of each of these covariates on women's odds of having hypertension.

Table 2 assesses changes in the age-adjusted risk of hypertension for Black and Hispanic women relative to White women when demographic characteristics (marital status, family size, nativity), socioeconomic status (educational level,

**Table 1. Characteristics of US women aged ≥18 years by racial and ethnic group**

| | White (W) (*n*=34,698) | Black (B) (*n*=8,077) | Hispanic (H) (*n*=9,055) | *P* Value from *t* Tests | | |
|---|---|---|---|---|---|---|
| | | | | W vs B | W vs H | B vs H |
| Ever diagnosed with hypertension, % | 25.0 | 33.7 | 19.5 | .000 | .000 | .000 |
| Age, mean (SD) | 47.6 (16.9) | 42.8 (18.6) | 40.2 (19.8) | .000 | .000 | .000 |
| US born, % | 95.3 | 90.1 | 38.9 | .000 | .000 | .000 |
| Married, % | 59.0 | 30.9 | 55.6 | .000 | .000 | .000 |
| Family size, mean (SD) | 2.6 (1.3) | 2.9 (1.7) | 3.6 (2.1) | .000 | .000 | .000 |
| Highest grade of school completed, % | | | | | | |
| Less than high school | 12.2 | 22.4 | 43.4 | .000 | .000 | .000 |
| High school diploma | 63.1 | 62.4 | 46.5 | .376 | .000 | .000 |
| College graduate | 24.7 | 15.3 | 10.1 | .000 | .000 | .000 |
| Family income-to-poverty ratio, mean (SD) | 9.8 (3.3) | 7.2 (4.3) | 6.8 (4.6) | .000 | .000 | .000 |
| Missing on income, % | 25.7 | 27.2 | 27.6 | .076 | .012 | .719 |
| Unemployed, % | 19.2 | 22.3 | 21.7 | .000 | .000 | .448 |
| Any money barriers to medical care, % | 13.6 | 17.7 | 17.9 | .000 | .000 | .843 |
| No medical insurance, % | 10.0 | 18.0 | 34.6 | .000 | .000 | .000 |
| How long since last saw a doctor, % | | | | | | |
| <6 months ago | 79.3 | 77.0 | 65.9 | .000 | .000 | .000 |
| 6 months to 1 year ago | 12.0 | 12.8 | 14.8 | .121 | .000 | .002 |
| >1 year ago | 8.7 | 10.2 | 19.3 | .001 | .000 | .000 |
| Smoking status, % | | | | | | |
| Current smoker | 21.8 | 18.3 | 10.9 | .000 | .000 | .000 |
| Former smoker | 21.5 | 11.7 | 10.0 | .000 | .000 | .002 |
| Never smoked | 56.6 | 70.0 | 79.1 | .000 | .000 | .000 |
| Drinking status, % | | | | | | |
| Lifetime abstainer | 23.2 | 41.9 | 49.6 | .000 | .000 | .000 |
| Former drinker | 14.5 | 15.3 | 10.7 | .135 | .000 | .000 |
| Current drinker, 1–2 per occasion | 48.2 | 33.4 | 28.4 | .000 | .000 | .000 |
| Current drinker, 3–4 per occasion | 9.6 | 5.8 | 7.8 | .000 | .000 | .000 |
| Current drinker, ≥5 per occasion | 3.0 | 1.6 | 2.7 | .000 | .248 | .000 |
| Frequency of physical activity, mean (SD) | 2.2 (1.0) | 1.8 (1.1) | 1.7 (1.2) | .000 | .000 | .002 |
| Body mass index, % | | | | | | |
| Underweight | 3.0 | 1.6 | 1.6 | .000 | .000 | .743 |
| Normal weight | 42.8 | 25.1 | 32.6 | .000 | .000 | .000 |
| Overweight | 33.3 | 33.6 | 40.3 | .572 | .000 | .000 |
| Obese | 20.9 | 39.7 | 25.4 | .000 | .000 | .000 |
| Diabetes, % | 5.7 | 9.7 | 6.5 | .000 | .032 | .000 |
| Depressive mood, mean (SD) | 1.4 (0.7) | 1.5 (0.9) | 1.5 (1.0) | .007 | .002 | .920 |

family poverty, employment status, financial barriers to medical care, health insurance status, time since last saw a doctor), lifestyle factors (smoking, alcohol use, BMI, physical activity, diabetes), and depressive mood are sequentially considered. Model 1, which adjusts only for age, shows that Black women are more than twice as likely as White women to have ever been diagnosed with hypertension (OR 2.37, 95% CI 2.19–2.56). Hispanic women are also at greater risk of hypertension than White women (OR 1.15, 95% CI 1.06–1.24), but the gap is much smaller relative to the difference between Black and White women.

Adding controls for other demographic characteristics in model 2 had no effect on the Black-White gap in the odds of hypertension but increased the odds ratio for Hispanic women slightly (OR 1.29, 95% CI 1.18–1.42), which indicates that part of the reason for the low rate of hypertension among Hispanic women is the large number of immigrants in our sample (ie, the odds of being diagnosed with hypertension is 26% higher among the native born). However, adjusting for socioeconomic status in model 3 causes the odds ratio to drop back to the same level it was before we adjusted for demographic measures, indicating that the poorer socioeconomic status of Hispanic women elevates their odds of hypertension in comparison to White women. Adjusting for socioeconomic status also results in a slight drop in the odds of hypertension among Black women (OR 2.20, 95% CI 2.03–2.38). No one measure of socioeconomic status is responsible for the reduction in racial disparities, as all measures show a significant association with hypertension. Increasing education and income reduces the odds of hypertension, while unemployment and financial barriers to medical care increase the odds of hypertension. Lacking medical insurance and increasing time since they last saw their doctor lowered

**Table 2. Odds ratios and confidence intervals from logistic regression models predicting hypertension among adult women**

| | Model 1: Age-Adjusted | | Model 2: Demographic | | Model 3: Socioeconomic | | Model 4: Lifestyle | | Model 5: Depression | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Race and ethnicity | | | | | | | | | | |
| Non-Latino White | 1.00 | (reference) | 1.00 | (reference) | 1.00 | (reference) | 1.00 | (reference) | 1.00 | (reference) |
| Non-Latino Black | 2.37‡ | (2.19–2.56) | 2.38‡ | (2.20–2.57) | 2.20‡ | (2.03–2.38) | 1.72‡ | (1.58–1.87) | 1.74‡ | (1.60, 1.90) |
| Hispanic | 1.15‡ | (1.06–1.24) | 1.29‡ | (1.18–1.42) | 1.15† | (1.03–1.27) | .99 | (.90–1.10) | .99 | (.90, 1.11) |
| Age | 1.06‡ | (1.06–1.07) | 1.06‡ | (1.06–1.07) | 1.06‡ | (1.06–1.06) | 1.06‡ | (1.05–1.06) | 1.06‡ | (1.06, 1.06) |
| US born | | | 1.26‡ | (1.15–1.38) | 1.20‡ | (1.10–1.32) | 1.11* | (1.01–1.23) | 1.12* | (1.02, 1.23) |
| Married | | | .98 | (.92–1.03) | 1.11‡ | (1.05–1.19) | 1.07* | (1.00–1.14) | 1.08* | (1.01, 1.15) |
| Family size | | | 1.02 | (.99–1.04) | 1.00 | (.97–1.03) | .99 | (.96–1.01) | .98 | (.96, 1.01) |
| Highest grade of school completed | | | | | | | | | | |
| Less than high school | | | | | 1.00 | (reference) | 1.00 | (reference) | 1.00 | (reference) |
| High school diploma | | | | | .85‡ | (.79–.91) | .90† | (.84–.97) | .91* | (.85, .98) |
| College graduate | | | | | .58‡ | (.52–.64) | .70‡ | (.63–.78) | .72‡ | (.65, .80) |
| Family income-to-poverty ratio | | | | | .97‡ | (.96–.98) | .98‡ | (.97–.99) | .98† | (.98, .99) |
| Unemployed | | | | | 1.26‡ | (1.18–1.35) | 1.21‡ | (1.12–1.30) | 1.15‡ | (1.06, 1.24) |
| Any money barriers to medical care | | | | | 1.54‡ | (1.42–1.67) | 1.36‡ | (1.24–1.48) | 1.27‡ | (1.16, 1.38) |
| No medical insurance | | | | | .88† | (.80–.97) | .92 | (.84–1.01) | .94 | (.85, 1.03) |
| How long since last saw a doctor | | | | | | | | | | |
| <6 months ago | | | | | 1.00 | (reference) | 1.00 | (reference) | 1.00 | (reference) |
| 6 months to 1 year ago | | | | | .47‡ | (.43–.52) | .52‡ | (.48–.57) | .53‡ | (.48, .58) |
| >1 year ago | | | | | .33‡ | (.29–.37) | .37‡ | (.33–.41) | .38‡ | (.33, .42) |
| Smoking status | | | | | | | | | | |
| Current smoker | | | | | | | 1.00 | (reference) | 1.00 | (reference) |
| Former smoker | | | | | | | 1.02 | (.93–1.11) | 1.04 | (.95, 1.13) |
| Never smoked | | | | | | | .98 | (.90–1.06) | 1.00 | (.93, 1.09) |
| Drinking status | | | | | | | | | | |
| Lifetime abstainer | | | | | | | 1.00 | (reference) | 1.00 | (reference) |
| Former drinker | | | | | | | 1.13† | (1.04–1.23) | 1.12* | (1.02, 1.21) |
| Current drinker, 1–2 per occasion | | | | | | | .97 | (.90–1.05) | .96 | (.89, 1.04) |
| Current drinker, 3–4 per occasion | | | | | | | .98 | (.86–1.11) | .96 | (.85, 1.09) |
| Current drinker, ≥5 per occasion | | | | | | | 1.05 | (.85–1.32) | 1.02 | (.82, 1.27) |
| Frequency of physical activity | | | | | | | .95‡ | (.92–.98) | .95‡ | (.92, .98) |
| Body mass index | | | | | | | | | | |
| Underweight | | | | | | | .75† | (.62–.92) | .75† | (.61, .91) |
| Normal weight | | | | | | | 1.00 | (reference) | 1.00 | (reference) |
| Overweight | | | | | | | 1.75‡ | (1.63–1.88) | 1.75‡ | (1.63, 1.88) |
| Obese | | | | | | | 3.49‡ | (3.23–3.76) | 3.45‡ | (3.20, 3.72) |
| Diabetes | | | | | | | 2.46‡ | (2.21–2.73) | 2.42‡ | (2.18, 2.69) |
| Depressive mood | | | | | | | | | 1.17‡ | (1.13, 1.22) |

All models control for survey year.
*N*=51,830.
*$P \leq .05$; †$P \leq .01$; ‡$P \leq .001$.

the odds of hypertension, but this likely reflects the necessity of having contact with a doctor to receive a diagnosis of hypertension, rather than an actual reduction in risk.

Model 4 adds controls for lifestyle characteristics, and we see a large effect on the racial/ethnic gap in hypertension: the odds ratio for Black women drops substantially (OR 1.72, 95% CI 1.58–187), and the odds ratio for Hispanic women is reduced to nonsignificance (OR .99, 95% CI .90–1.10). While adjusting for smoking and alcohol use had little effect on the racial/ethnic gap in hypertension, measures related to weight and exercise are much more important. Black and Hispanic women report less physical activity, higher BMIs, and higher rates of diabetes than White women, and each of these is a strong, significant predictor of hypertension.

Finally, model 5 adds a control for depressive mood. While this adjustment has a significant, positive effect on hypertension, adjusting for depressive mood does not mediate the relationship between race/ethnicity and hypertension, as the odds ratios for Black and Hispanic women change little or not at all in comparison to the previous model (Black women: OR 1.74, 95% CI 1.60–1.90; Hispanic women: OR .99, 95% CI .90–1.11). However, while depression does not mediate the association between race/ethnicity and hyperten-

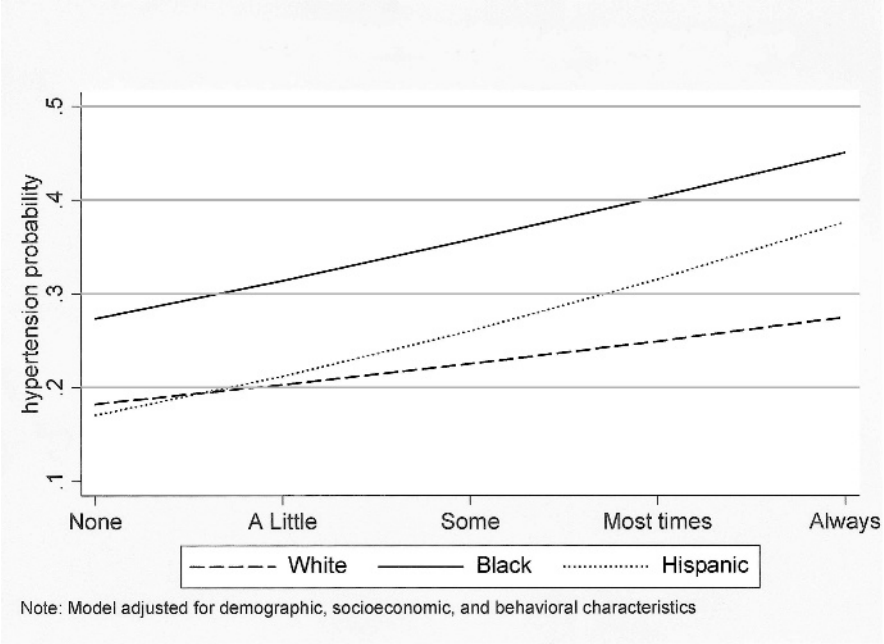


**Fig 1. Adjusted probability of hypertension by race and depression level, adult women aged >18 years**

sion, it may moderate the association in that the strength of the association between depression and hypertension may vary by racial and ethnic group. To test for this possibility, we added an interaction term between race/ethnicity and depression to model 5 (not shown). The interaction was significant, and for ease of interpretation we illustrate this relationship in Figure 1, which graphs predicted probabilities for hypertension by race/ethnicity and depressive mood (adjusted for all measures listed in model 5 of Table 2).

Figure 1 shows that the probability of being diagnosed with hypertension increases with rising levels of depression for all groups, but the size of the relationship differs across racial/ethnic groups. Even after adjustment for other covariates, Black women experience a significantly higher probability of hypertension across all levels of depression. Among women who report no depressive feelings, ≈17% of White and 18% of Hispanic women are hypertensive, compared to 27% of Black women. However, among women who report the highest levels of depression (ie, those who feel symptoms of depression every day), 45% of Black women are hypertensive, compared to 37% of Hispanic and 27% of White women. Thus, with rising levels of depressive mood, Black and Hispanic women experience similar rates of increase in the odds of hypertension (an 18% and 19% gap, respectively, between women with no depression and those who are depressed every day), while the increase for non-Hispanic White women is significantly lower (only a 10% gap between women who are the least and most depressed).

## DISCUSSION

Reducing the prevalence of hypertension is a primary goal for public health officials, and efforts to identify factors that contribute to disparities by age, sex, and race/ethnicity are central to this aim. Although the higher prevalence of hypertension among some racial/ethnic minorities has been established, less is known about how sex contributes to these patterns. Given that women have longer life expectancies than men and that hypertension prevalence is greater in elderly women,[9] identifying factors that contribute to differences in women's risk of hypertension is paramount.

*Depression was positively associated with an increased risk of hypertension for all groups of women in this study, but the relationship was stronger for Hispanic and Black women than for White women.*

The current study addresses this question by examining racial/ethnic differences in the prevalence and odds of hypertension among adult women and assessing the degree to which depression, lifestyle, demographic, and socioeconomic characteristics account for observed disparities between groups. We were particularly interested in examining whether depression operates as a mediating mechanism between race/ethnicity and hypertension or whether the effect of depression on hypertension is conditional on racial/ethnic group membership. We observed the following: 1) compared to White women, the age-adjusted risk of hypertension was considerably higher among Black women and only slightly higher among Hispanic women; 2) adjustment for a host of possible explanatory factors, particularly BMI, physical activity, and diabetes, eliminated the gap between Hispanic and White women but did not close the gap between Black and White women; and 3) while depression does not mediate the relation-

ship between race/ethnicity and hypertension, depression does have a greater effect on minority women's odds of hypertension than the odds of hypertension for White women.

The findings for depression are particularly informative since the relationship between race/ethnicity and depression has not been well studied. Depression was positively associated with an increased risk of hypertension for all groups of women in this study, but the relationship was stronger for Hispanic and Black women than for White women. As discussed by Jackson and Williams,[27] studies have established that women and minority groups feel less control over life circumstances, greater amounts of hopelessness and demoralization, and report more negative life events than men and Whites. We are unable to directly explore the role of stress for hypertension in this paper because of the lack of information on stress in the NHIS data, an unfortunate limitation since research has shown that stress has a significant impact on hypertension rates, especially among African Americans.[32] That Hispanic and Black women are more vulnerable to hypertension when they feel symptoms of depression may indicate that the sources of their stress and depression differ (eg, racial discrimination, acculturative stress), are more numerous, or are more intense than for White women.

While we document that hypertension is not as tightly bound to depression for White women as it is for minority women, our findings also indicate that we are better able to explain differences in depression between White and Hispanic women than we are for differences between White and Black women. Indeed, our logistic regression models show that adjusting for demographic characteristics, socioeconomic status, health lifestyle, and depression accounted for differences in hypertension between Hispanic and White women. Even though the socioeconomic profile of Hispanic women in our study is significantly worse than it is for Black women, the greater similarity in hypertension risk for Hispanic and White women mirrors that seen in other studies that document better-than-expected health outcomes among Hispanics given their poor socioeconomic profile.[33] The differences that existed between Hispanic and White women were attenuated by the measures included in this paper, namely by differences in physical activity, BMIs, and rates of diabetes–all of which disadvantage Hispanic women relative to White women.

In Black women, however, adjusting for these measures resulted in a relatively minor reduction in their odds of hypertension. Given the high rate of hypertension among Black women – and particularly among Black women who experience daily symptoms of depression – additional research with a more expansive set of explanatory measures related to aspects of stress, social support, discrimination and racism are necessary if the racial pattern in this paper is to be more fully understood. In particular, racism and discrimination need to be explicitly measured in future studies, as both have been found to be stressors that negatively influence the health of Black Americans (including but not limited to elevated blood pressure).[34–36] The findings from these prior studies have been inconsistent, however, in part because racism and discrimination are difficult concepts to measure and are often poorly captured or missing altogether in population-based studies, including in the NHIS sample examined in this paper.

This study is not without limitations. First, in addition to lacking specific information on racism and discrimination, the dearth of information on the psychosocial status of women in the NHIS is regrettable, as women report lower self-esteem and personal control than men, and women are more likely to experience stressful life events and chronic stressors in their social roles that, in turn, increase their likelihood of depression and poor physical health.[37–40] Second, readers should keep in mind that the measure of depression used in this paper is a measure of short-term depressive mood. As such, the pattern of association we describe with race/ethnicity and hypertension may differ if a more severe and ongoing form of depression was examined.

Despite these limitations, this study has the advantage of using a large enough sample to compare the health profiles of multiple racial/ethnic groups of US women, which is not possible with smaller datasets derived from clinical trials or community-specific health surveys. The data used in this study also contain many of the risk factors that are known to influence hypertension (eg, health lifestyle, socioeconomic status) and as such, allows us to provide a fairly comprehensive overview of the possible contributors to racial/ethnic disparities in women's health.

In conclusion, since women are 1.5–3 times more likely to suffer from depression than men,[24] the link between depression and hypertension documented in this and previous studies highlights the importance of considering mental and physical health in tandem when investigating the factors associated with both gender and racial disparities in health. While the body of research knowledge on health disparities is growing, there is much we do not understand about the underlying causes of often-persistent group differences in health status. Acknowledging the link between mental and physical health, and its role in contributing to health disparities, is a necessary step if we are to develop and implement policy solutions that hope to remedy long-standing racial and ethnic disparities in the health status of women and men in the United States.

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*Data analysis and interpretation:* Read, Gorman
*Manuscript draft:* Read, Gorman
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*Supervision:* Read