




## ORIGINAL PAPER

# Exploring racial/ethnic disparities in hypertension care among patients served by health centers in the United States

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Some racial/ethnic minorities are more likely to have hypertension and experience increased hypertension-related morbidity and mortality compared to whites. Health Resources and Services Administration-funded health centers care for over 27 million patients, 62 percent of whom are racial/ethnic minorities. We assessed the presence of racial/ethnic disparities in (a) hypertension management and (b) hypertension outcomes among health center patients. We used data from the 2014 Health Center Patient Survey and performed multilevel logistic regression models to predict hypertension management counseling, patient adherence to counseling and medication regimen, management plan receipt, high blood pressure at last clinical visit, confidence in hypertension self-management, and hypertension-related emergency department (ED) episodes or hospitalizations in the past year. We controlled for patient characteristics including age, sex, education, nativity, health behaviors, health care access, and comorbidities. We found significantly higher odds of diet counseling (African Americans, OR: 1.87; Asian Americans, OR: 3.02, AIAN, OR: 2.01), reduced sodium intake (African American, OR: 2.42), and adherence to exercise counseling (African American, OR: 3.52; Asian Americans, OR: 2.93). We also found lower odds of taking hypertension control medication (AIAN, OR: 0.50) and higher odds of hypertension-related ED visits (African Americans, OR: 3.61, AIAN, OR: 5.31). These results highlight the success of health centers in managing hypertension by race/ethnicity but found adverse hypertension outcomes for some groups. Racial/ethnically tailored efforts might be required to manage hypertension and improve outcomes.

## 1 | INTRODUCTION

More than a third (46 percent) of American adults have hypertension, an estimated 103.3 million individuals across the United States, based on new hypertension guidelines.<sup>1</sup> Hypertension rates are highest (65.6 percent) among adults over 60 years of age, but 7.3 percent of younger adults ages 18-39 also have hypertension.<sup>2</sup> The rate of hypertension has been relatively stable from 1999 to 2014 with a concurrent increase in rates of hypertension awareness, treatment, and control.<sup>3</sup> Hypertension has been among the top ranking medical diagnoses and represents the single most important underlying

cause of heart disease and stroke, which are the most common causes of mortality in the United States.<sup>4-7</sup> Beyond its health consequences, hypertension management and treatment is costly. For example, hypertension consistently ranks as one of the primary reasons to visit a doctor.<sup>8</sup> Hypertension-related emergency department (ED) visits are also rising, and patients with hypertension have longer hospital stays and incur greater costs.<sup>9,10</sup>

Hypertension takes on further national significance as its burden and impact is unequally distributed across the nation's populations.<sup>11,12</sup> Racial and ethnic minorities, particularly African Americans, have higher rates of hypertension morbidity and mortality

compared to Whites.<sup>13-15</sup> Lower rates of hypertension awareness, treatment, and control among Hispanics and hypertension control among African Americans as compared to Whites may explain these disparities in outcomes.<sup>11,13,16</sup> Strategies are needed to control hypertension and address health disparities in primary care settings that serve all racial/ethnic groups. Existing strategies have included education, screening and monitoring, adherence to treatment guidelines, and patient self-management support.<sup>17,18</sup> Home management programs have proven more effective among non-Hispanic African Americans compared to Whites, and Hispanic adults who received culturally competent lifestyle interventions to lower their blood pressure achieved better blood pressure control.<sup>19-21</sup>

The main goal of our study is to identify potential racial/ethnic disparities in hypertension care and outcomes for patients served at health centers funded by the Health Resources and Services Administration (HRSA). In 2017, HRSA-funded health centers provided services to nearly 27 million medically vulnerable and geographically isolated Americans, 62 percent of whom are racial/ethnic minorities and 92 percent of whom live below 200 percent of the federal poverty level.<sup>22</sup> Health centers are the largest providers of comprehensive primary care within the safety net, with more than 11 000 clinical sites operated by roughly 1400 awardees.<sup>23</sup> Health centers also provide important enabling services, such as linkages to social service providers, health education, and care coordination, to address barriers to access and social determinants of health that might lead to more expensive acute care episodes including hospitalizations and ED visits.<sup>24,25</sup>

Given the racial/ethnic mix of health center patients and the high national prevalence of hypertension, we explored whether racial/ethnic disparities existed in receipt of and adherence to treatment and care recommendations, and outcomes including patients' confidence in hypertension self-management, control of hypertension, and ED visits or hospitalizations due to hypertension.<sup>26,27</sup> We used the Andersen model of health care utilization in our study to guide the analyses and identify key predisposing, enabling, and need determinants of use of services.<sup>28,29</sup>

## 2 | METHODS

### 2.1 | Data

We used data from the 2014 Health Center Patient Survey sponsored by the Health Resources and Services Administration.<sup>30</sup> The survey produced cross-sectional, nationally representative data on patients served by health centers funded through Section 330 of the Public Health Service Act. A three-stage sampling design was used to obtain the sampling frame. First-stage sampling units were health center grantees, second-stage sampling units were eligible clinic sites, and third-stage sampling units were eligible patients with at least one visit in the past year to eligible clinic sites. Samples were also distributed across regions (Northeast, Midwest, South, West), urban/rural location, and number of service delivery sites per grantee. The third and final stage selected individual patients within

service sites, and a total of 7002 patient interviews were completed between October 2014 and April 2015. Due to the sampling design, we weighted the results to reflect national estimates. Upon interview completion, respondents received \$25 in cash or gift card. Institutional Review Board (IRB) approval was obtained by Research Triangle International, the contractor responsible for data collection. Local IRB or other committee approvals were obtained where necessary.

In-person questionnaires were administered by trained interviewers and lasted on average 52 minutes. Surveys were conducted in English, Spanish, Vietnamese, Korean, and Chinese (Mandarin and Cantonese). Interview questions were modeled after the National Health Interview Survey (NHIS), National Ambulatory Medical Care Survey (NHAMCS), Medical Expenditure Panel Survey (MEPS), and National Health and Nutrition Examination Survey (NHANES) and focused on sociodemographic characteristics, health conditions, health behaviors, access to and use of health care services, and satisfaction with health care.

### 2.2 | Sample

We calculated the rate of hypertension among adults ages 18 and over using all adults (5592). For the remainder of the analyses, we restricted our sample to adults 18 years of age and over who were ever told by a clinician that they had hypertension and their usual source of care was the health center site at which they were interviewed. Our final analytical sample size of was 2365.

### 2.3 | Dependent variables

The dependent variables were based on patient response to survey questions and included (1) receipt of counseling about diet, (2) sodium intake, (3) exercise, and (4) alcohol consumption to manage hypertension by a health center health provider, (5) receipt of a hypertension management plan, (6) patient adherence to recommendations of diet change, (7) reduced sodium intake, (8) exercise, and (9) reduced alcohol consumption, (10) taking medication for hypertension, (11) patient confidence in ability to self-manage hypertension, (12) high blood pressure at most recent clinical visit, and (13) hypertension-related ED visits or hospitalizations in the past 12 months. Variables 1-5 indicate provider interventions to manage hypertension. Variables 6-10 indicate adherence to provider recommendations. Variables 11-13 indicate likely outcomes of hypertension management. All variables were dichotomous, with the exception of patients' confidence in managing their hypertension, which was dichotomized into "very confident" vs "somewhat confident/not too confident/not at all confident." Detailed description of dependent variable construction and survey questions are presented in the Appendix S1.

### 2.4 | Independent variables

The primary independent variable of interest was self-reported race/ethnicity, coded as non-Hispanic White, Hispanic/Latino,

non-Hispanic African American, non-Hispanic Asian American, non-Hispanic American Indian and Alaska Native (AIAN), and non-Hispanic other. The latter group included non-Hispanic Native Hawaiians and Pacific Islanders and those reporting multiple races due to small sample size.

We controlled for potential confounders including predisposing factors such as self-reported age (18-44, 45-64, and 65 years and over), sex (male vs female), educational attainment (at least high school graduate vs less), and nativity (US born vs not). Enabling factors included being insured (vs uninsured) at time of interview, having unmet medical need (vs not), and having delayed medical care in the past year (vs not). Need indicators included self-assessed health status (fair or poor health vs good, very good, or excellent), hypercholesterolemia, diabetes, cardiovascular disease, overweight or obese status (body mass index of <25.0 as normal or underweight, 25-29.99 as overweight, and 30 or higher as obese), and current smoking (vs never or previous smoker).

## 2.5 | Statistical analysis

We examined differences in predisposing, enabling, and need factors by race/ethnicity in descriptive analyses. We used multilevel logistic regression models to examine the relationship between race/ethnicity and each dependent variable, controlling for potential confounders. Multilevel models accounted for nesting of patients within health center organizations, and all analyses were weighted to account for the complex sample design. We used STATA version 15.1 to analyze the data and discussed results with probability values of 0.05 or smaller.<sup>31</sup>

## 3 | RESULTS

### 3.1 | Descriptive results

Our sample of 2365 was representative of 6 137 783 patients with hypertension receiving care in health centers (Table 1). The majority (52 percent) of the sample was 45-64 years of age, US born (87 percent), and had at least high school education (66 percent). The majority (75 percent) were insured and some had experienced unmet need (10 percent) or delays in care (13 percent). Most (55 percent) reported fair or poor health had hypercholesterolemia (54 percent) and were obese (64 percent). Many were also overweight (24 percent), had diabetes (37 percent), cardiovascular disease (21 percent), and were current smokers (29 percent).

The majority of patients received recommendations to change their diet (60 percent), reduce sodium intake (77 percent), or increase exercise (76 percent), but fewer received recommendations to reduce alcohol consumption (34 percent). Fewer (39 percent) reported receiving a hypertension management plan. The great majority of patients reported adherence to recommendations of diet change (87 percent), sodium reduction (95 percent), increased exercise (78 percent), and alcohol reduction (95 percent). Patients frequently reported taking medications to control their

hypertension (84 percent). The majority reported high confidence in their self-management (66 percent), but more than half had high blood pressure at their last clinical visit (53 percent), and some had a hypertension-related ED visit or hospitalization in the last year (10 percent).

## 3.2 | Multivariate results

### 3.2.1 | Health center provider interventions to manage hypertension

After adjusting for key predisposing, enabling, and need factors, we found racial/ethnic disparities in the receipt of hypertension management counseling for diet change and reduced sodium intake. Non-Hispanic African Americans were more likely to receive recommendations for diet change (OR = 1.87) and reducing sodium intake (OR = 2.42) than their non-Hispanic White counterparts (Table 2). Non-Hispanic Asian Americans (OR = 3.02) and non-Hispanic AIANs (OR = 2.01) were also more likely to receive diet change recommendations compared to non-Hispanic Whites. There were no racial/ethnic differences in receipt of counseling to exercise or reduce alcohol and no differences in receipt of a self-management plan.

### 3.2.2 | Patient adherence to provider counseling and use of hypertension medication

There were no racial/ethnic disparities in the adherence to diet change and reduced sodium intake (Table 3). However, non-Hispanic African Americans (OR = 3.52), non-Hispanic Asian Americans (OR = 2.93), and non-Hispanic others (OR = 8.97) were more likely to report adhering to exercise recommendations. Only non-Hispanic AIAN patients were less likely to take medication to control their hypertension (OR = 0.50), but no other groups were different from non-Hispanic Whites.

### 3.2.3 | Hypertension management outcomes

There were no racial/ethnic disparities in patient self-confidence of hypertension management (Table 4). But, we found non-Hispanic African American (OR = 0.36) and non-Hispanic Asian American (OR = 0.40) patients were less likely to report being told by a provider they had high blood pressure at their last visit. We also found that non-Hispanic African Americans (OR = 3.61) and non-Hispanic AIAN (OR = 5.31) were more likely to have an ED visit or hospitalization due to hypertension.

## 4 | DISCUSSION

Previous research identified disparities in hypertension prevalence, awareness, and management by race/ethnicity.<sup>15,32</sup> In our examination of a nationally representative sample of health center patients with hypertension, we found a higher likelihood of hypertension

**TABLE 1** Predisposing, enabling, and need determinants of HC patients with hypertension

	Total	Non-Hispanic White	Hispanic/Latino	Non-Hispanic African American	Non-Hispanic Asian American	Non-Hispanic American Indian, Alaska Native (AIAN)	Non-Hispanic Other (%)
<b>Sample size</b>	<b>2365 (Weighted n = 6 137 783)</b>	<b>633 (27%)</b>	<b>630 (27%)</b>	<b>689 (29%)</b>	<b>128 (5%)</b>	<b>228 (10%)</b>	<b>57 (2%)</b>
<b>Predisposing determinants</b>							
<b>Age</b>							
18-44 y	31%	29%	34%	34%	6%	19%	34%
45-64 y	52%	51%	47%	56%	64%	60%	56%
65+ y	17%	19%	19%	10%	30%	21%	10%
Male (vs female)	46%	46%	49%	44%	36%	41%	62%
US born (vs not)	87%	98%	42%	92%	14%	82%	94%
High school graduate (vs less)	66%	73%	44%	64%	57%	56%	64%
Employed (vs not)	31%	29%	34%	38%	28%	20%	10%
<b>Enabling determinants</b>							
Currently insured (vs not)	75%	75%	74%	74%	80%	79%	99%
Unmet medical need in past year (vs not)	10%	11%	11%	6%	1%	16%	1%
Delayed medical care in past year (vs not)	13%	14%	12%	8%	8%	15%	10%
<b>Need determinants</b>							
Self-reported fair/poor health status (vs good, very good, excellent)	55%	53%	58%	57%	75%	59%	40%
Hypercholesterolemia	54%	55%	62%	48%	52%	52%	45%
Diabetes	37%	38%	38%	35%	42%	45%	13%
Cardiovascular disease	21%	27%	14%	9%	3%	21%	54%
<b>Body mass index/BMI</b>							
Normal or underweight (BMI 0-24.99)	12%	12%	13%	11%	55%	16%	2%
Overweight (BMI 25.0-29.99)	24%	23%	20%	32%	36%	12%	42%
Obese (BMI 30.0 or higher)	64%	65%	67%	56%	9%	71%	57%
Current smoker (vs not)	29%	35%	15%	24%	7%	28%	56%
<b>Dependent variables</b>							
<b>Received hypertension management counseling (n = 2365)</b>							
Diet change	60%	57%	67%	66%	67%	65%	51%
Reduce sodium intake	77%	75%	75%	83%	79%	67%	70%
Increase exercise	76%	77%	68%	77%	87%	76%	75%
Reduce alcohol consumption	34%	29%	45%	36%	55%	27%	43%
<b>Received hypertension management plan (n = 2365)</b>							
<b>Adhered to hypertension management counseling</b>							
Diet change (n = 1481)	87%	89%	85%	83%	98%	80%	90%
Reduce sodium intake (n = 1822)	95%	95%	96%	95%	99%	90%	99%
Increase exercise (n = 1724)	78%	74%	78%	87%	97%	77%	98%
Reduce alcohol consumption (n = 928)	95%	95%	95%	94%	100%	95%	100%

(Continues)

TABLE 1 (Continued)

	Total	Non-Hispanic White	Hispanic/Latino	Non-Hispanic African American	Non-Hispanic Asian American	Non-Hispanic American Indian, Alaska Native (AIAN)	Non-Hispanic Other (%)
Sample size	2365 (Weighted n = 6 137 783)	633 (27%)	630 (27%)	689 (29%)	128 (5%)	228 (10%)	57 (2%)
Takes medication to control hypertension (n = 2365)	84%	88%	79%	77%	87%	79%	81%
Reported being very confident in hypertension self-management vs less or not confident (n = 2365)	66%	68%	65%	62%	60%	56%	53%
Had high blood pressure at last clinical visit (n = 2365)	53%	58%	47%	44%	35%	45%	54%
Had ED visit or was hospitalized last year due to hypertension (n = 2365)	10%	6%	12%	19%	7%	17%	1%

BMI, body mass index; ED, emergency department.

counseling in diet change and sodium intake for some racial/ethnic groups and equal likelihood of receiving counseling in exercise and alcohol reduction, as well as self-management plans for all racial/ethnic groups. The higher likelihood of receiving diet change for non-Hispanic African Americans, Asian Americans, and AIAN, as well as reducing sodium intake for Asian Americans may be consistent with higher prevalence of poorer diets and high sodium intake among these groups, respectively.<sup>33-35</sup> However, lack of racial/ethnic differences for the remaining provider interventions may suggest evidence-based and consistent recommendations and practices by health center providers.

The rates of adherence to provider recommendation including diet (87%) and low sodium foods (95%) in our sample are consistent with other self-reported national surveys.<sup>36,37</sup> The findings of no racial/ethnic differences in adherence to diet change, sodium intake, and alcohol reduction counseling may reflect equal adherence among all groups. The findings of higher adherence to exercise recommendations by non-Hispanic African Americans and Asian Americans may reflect the higher propensity of these individuals to use exercise as a preferred option to manage their obesity, including those with hypertension.<sup>38</sup> Higher adherence may further be explained by greater social desirability bias and responding affirmatively to questions regardless of how they are phrased, particularly among some racial/ethnic groups.<sup>39-41</sup> The lower rates of AIAN populations who reported taking hypertension medication are more difficult to interpret because not all patients are managed with medication.<sup>42</sup> This lower likelihood may reflect lower hypertension literacy levels, unavailability of social support systems that promote treatment adherence, or need for more medication prescriptions in this population.<sup>43</sup>

Our findings of no racial/ethnic differences in confidence of self-management may reflect health center providers' consistent efforts at developing patients' hypertension management skills for

all groups. The lower likelihood of high blood pressure at last visit among non-Hispanic African Americans and Asian Americans suggests that these patients may have their hypertension under control and is consistent with higher adherence to providers' exercise recommendations. Since health center serve a majority of racial minority patients, providers may be more aware of such hypertension disparities affecting these groups and provide more targeted intervention. However, higher likelihood of hypertension-related ED visit or hospitalization among non-Hispanic African Americans is not consistent with our other results. This finding may reflect unanticipated complications or higher severity of hypertension for this group.<sup>44,45</sup> Alternatively, the higher likelihood of hypertension-related ED visit or hospitalization for non-Hispanic AIANs may be related to lower medications adherence or the need for such medications among these patients.

Lack of hypertension-related disparities among some racial/ethnic minority groups and better results among others reflect, in part, health centers' success in appropriate care delivery to their diverse patients with hypertension. The limited instances when we found disparities suggest areas that warrant further study and opportunity for quality improvement efforts. For instance, non-Hispanic AIAN patients may require additional culturally competent coaching to improve adherence to taking their medications, or a closer examination of whether such medications should be prescribed. Similarly, understanding the reasons for ED visits or hospitalizations despite adherence to counseling and controlled hypertension is warranted. Health center providers may need to address social and environmental factors to effectively improve the health of some groups. Delivering care in an equitable manner within the four walls of a clinical setting is not enough. This understanding has been recognized as a priority area in HRSA's strategic plan to leverage programs and policies to further integrate services and address social determinants of health.<sup>46</sup>

**TABLE 2** Adjusted odds ratios and 95% confidence intervals for factors associated with receipt of hypertension management counseling and self-management plan

	Diet change counseling (n = 2276)	Reduce sodium counseling (n = 2275)	Exercise counseling (n = 2274)	Reduce alcohol counseling (n = 2255)	Received self-management plan (n = 2041)
Sample size	OR (95% CI)				
Race/ethnicity (ref: non-hispanic white)					
Hispanic/Latino	1.53 (0.85,2.76)	1.19 (0.68,2.07)	0.75 (0.43,1.31)	1.02 (0.55,1.89)	0.77 (0.42,1.40)
Non-hispanic African American	1.87** (1.22,2.85)	2.42*** (1.57,3.74)	1.06 (0.68,1.64)	1.60 (0.94,2.73)	1.33 (0.83,2.15)
Non-Hispanic Asian American	3.02* (1.01,9.02)	1.09 (0.47,2.51)	1.78 (0.67,4.73)	1.03 (0.36,2.99)	0.74 (0.26,2.14)
Non-Hispanic American Indian/Alaska Native	2.01* (1.15,3.52)	0.78 (0.44,1.39)	0.59 (0.30,1.15)	1.02 (0.46,2.28)	0.73 (0.34,1.57)
Non-Hispanic other	0.45 (0.13,1.58)	0.91 (0.26,3.18)	0.88 (0.18,4.25)	0.87 (0.30,2.54)	0.81 (0.19,3.58)
Predisposing determinants					
Age (ref: 18-44)					
45-64 y	0.79 (0.52,1.21)	0.89 (0.57,1.39)	0.76 (0.48,1.21)	0.80 (0.53,1.20)	1.16 (0.74,1.82)
65+ y	0.55* (0.30,0.99)	0.68 (0.36,1.28)	0.41* (0.21,0.83)	0.36** (0.18,0.72)	0.90 (0.51,1.59)
Male (vs female)	1.22 (0.86,1.72)	1.01 (0.71,1.45)	1.19 (0.87,1.63)	2.73*** (1.96,3.79)	1.13 (0.83,1.55)
US born (vs not)	0.57 (0.29,1.09)	0.60 (0.35,1.04)	0.48* (0.24,0.92)	0.49** (0.29,0.84)	0.94 (0.49,1.79)
High school graduate (vs less)	1.48* (1.08,2.02)	0.93 (0.61,1.43)	1.18 (0.86,1.64)	1.00 (0.68,1.45)	1.16 (0.84,1.62)
Employed (vs not)	0.82 (0.57,1.19)	0.96 (0.66,1.42)	0.77 (0.48,1.24)	0.87 (0.55,1.37)	1.03 (0.68,1.56)
Enabling determinants					
Currently insured (vs not)	0.82 (0.51,1.32)	1.09 (0.64,1.84)	0.71 (0.42,1.20)	0.78 (0.52,1.15)	1.15 (0.77,1.74)
Unmet medical need in past year (vs not)	0.87 (0.44,1.73)	0.93 (0.47,1.84)	1.15 (0.57,2.31)	1.67 (0.88,3.18)	1.51 (0.81,2.84)
Delayed medical care in past year (vs not)	1.40 (0.81,2.42)	1.64 (0.94,2.87)	0.79 (0.47,1.31)	1.16 (0.67,2.00)	0.56* (0.34,0.93)
Need determinants					
Self-reported fair/poor health status (vs good, very good, excellent)	0.79 (0.56,1.10)	0.86 (0.58,1.26)	0.84 (0.59,1.20)	0.88 (0.59,1.33)	0.86 (0.58,1.27)
Hypercholesterolemia	2.07*** (1.45,2.97)	1.88** (1.29,2.74)	1.51* (1.05,2.17)	1.21 (0.83,1.75)	1.28 (0.84,1.94)
Diabetes	0.88 (0.62,1.27)	1.00 (0.66,1.52)	1.25 (0.83,1.88)	0.91 (0.63,1.33)	1.55* (1.09,2.22)
Cardiovascular disease	1.58* (1.09,2.30)	1.96** (1.19,3.22)	1.51 (0.97,2.35)	1.17 (0.74,1.86)	1.66* (1.07,2.57)
Body mass index (ref: BMI 0-24.99)					
Overweight (BMI 25.0-29.99)	1.99** (1.23,3.21)	1.15 (0.69,1.93)	1.69* (1.01,2.84)	0.85 (0.49,1.47)	1.34 (0.77,2.32)
Obese (BMI 30.0 or higher)	4.39*** (2.79,6.91)	1.92** (1.17,3.16)	3.02*** (1.93,4.74)	0.83 (0.50,1.37)	1.16 (0.69,1.96)
Current smoker	0.90 (0.64,1.26)	0.72 (0.49,1.05)	0.63* (0.44,0.91)	1.29 (0.89,1.88)	1.25 (0.88,1.77)

BMI, body mass index.

\* $P < 0.05$ .\*\* $P < 0.01$ .\*\*\* $P < 0.001$ .

These findings underscore the importance of evidence-based hypertension care and the potential for better outcomes with appropriate provision of preventive and primary care. HRSA-funded

health centers strive to provide equitable access to care, regardless of patients' ability to pay or racial/ethnic background. The comprehensive array of services include non-medical enabling

**TABLE 3** Adjusted odds ratios and 95% confidence intervals for factors associated with adherence to hypertension management counseling and medication

	Diet change (n = 1425)	Reduce sodium (n = 1750)	Exercise (n = 1663)	Reduce alcohol (n = 890)	Take medication to control hypertension (n = 2275)
Sample size	OR (95% CI)				OR (95% CI)
Race/ethnicity (ref: non-Hispanic White)					
Hispanic/Latino	1.64 (0.57,4.69)	0.96 (0.29,3.20)	1.32 (0.64,2.72)	1.55 (0.29,8.25)	0.62 (0.30,1.29)
Non-Hispanic African American	1.13 (0.54,2.38)	1.81 (0.83,3.93)	3.52*** (1.92,6.46)	1.04 (0.27,4.02)	1.46 (0.76,2.81)
Non-Hispanic Asian American	-	0.76 (0.14,4.10)	2.93* (1.13,7.55)	-	1.02 (0.30,3.52)
Non-Hispanic American Indian/Alaska Native	0.82 (0.29,2.34)	0.59 (0.14,2.42)	2.11 (0.89,5.00)	0.84 (0.17,4.21)	0.50* (0.25,0.98)
Non-Hispanic other	1.23 (0.28,5.42)	3.56 (0.59,21.52)	8.97** (2.02,39.92)	-	0.74 (0.14,4.03)
Predisposing determinants					
Age (ref: 18-44)					
45-64 y	1.74 (0.93,3.25)	0.75 (0.36,1.56)	0.81 (0.44,1.53)	1.14 (0.29,4.55)	4.92*** (2.75,8.79)
65+ y	2.59 (0.89,7.60)	0.81 (0.23,2.87)	1.04 (0.42,2.57)	1.21 (0.08,17.61)	10.41*** (4.72,22.95)
Male (vs female)	1.32 (0.72,2.40)	0.93 (0.45,1.92)	1.21 (0.79,1.86)	0.92 (0.28,3.01)	1.19 (0.81,1.74)
US born (vs not)	1.72 (0.59,5.03)	0.22* (0.06,0.83)	0.83 (0.42,1.66)	1.76 (0.40,7.85)	0.43** (0.23,0.82)
High school graduate (vs less)	0.76 (0.39,1.48)	0.88 (0.42,1.86)	0.73 (0.44,1.21)	0.64 (0.18,2.32)	0.87 (0.56,1.34)
Employed (vs not)	1.83 (0.94,3.56)	0.58 (0.29,1.17)	0.75 (0.48,1.15)	1.29 (0.47,3.50)	1.11 (0.74,1.65)
Enabling determinants					
Currently insured (vs not)	0.90 (0.43,1.88)	0.63 (0.21,1.91)	1.31 (0.76,2.25)	0.54 (0.16,1.85)	1.10 (0.65,1.86)
Unmet medical need in past year (vs not)	1.16 (0.37,3.64)	1.48 (0.35,6.20)	0.83 (0.35,1.97)	2.88 (0.66,12.58)	0.61 (0.32,1.17)
Delayed medical care in past year (vs not)	1.09 (0.47,2.55)	0.38** (0.19,0.79)	1.51 (0.70,3.25)	5.92* (1.41,24.93)	0.58 (0.24,1.41)
Need determinants					
Self-reported fair/poor health status (vs better)	1.23 (0.70,2.15)	0.73 (0.30,1.76)	0.34*** (0.20,0.56)	0.65 (0.18,2.27)	1.45 (0.81,2.58)
Hypercholesterolemia	0.62 (0.38,1.04)	1.04 (0.56,1.95)	0.78 (0.51,1.17)	1.02 (0.34,3.01)	1.25 (0.77,2.02)
Diabetes	1.85* (1.01,3.41)	0.83 (0.41,1.67)	1.25 (0.78,1.99)	0.76 (0.26,2.20)	1.69 (0.93,3.07)
Cardiovascular disease	0.32*** (0.18,0.55)	3.37* (1.32,8.59)	0.84 (0.48,1.49)	1.12 (0.29,4.30)	1.14 (0.61,2.13)
Body mass index (ref: BMI 0-24.99)					
Overweight (BMI 25.0-29.99)	1.69 (0.72,3.99)	2.33 (0.99,5.50)	0.48 (0.21,1.12)	1.56 (0.36,6.65)	2.24** (1.22,4.11)
Obese (BMI 30.0 or higher)	2.40* (1.00,5.74)	2.16 (0.89,5.20)	0.56 (0.25,1.25)	5.58** (1.52,20.57)	3.83*** (2.30,6.38)
Current smoker	1.07 (0.60,1.89)	0.48 (0.23,1.02)	0.58* (0.34,0.97)	0.88 (0.25,3.09)	0.72 (0.47,1.11)

-, Indicated every patient in this category reported positively to adhering to these provider recommendations.

BMI, body mass index.

\* $P < 0.05$ .

\*\* $P < 0.01$ .

\*\*\* $P < 0.001$ .

services that facilitate access to timely and appropriate medical care, such as transportation, interpretation, translation, targeted case management, community outreach, and educational programs.<sup>25</sup>

#### 4.1 | Limitations

Our primary limitation was that our data are cross-sectional, and our findings are restricted to associations. Also, all survey

**TABLE 4** Odds ratios and 95% confidence intervals for factors associated with self-confidence in managing hypertension, high blood pressure at last clinical visit, and emergency department visit or hospitalization due to hypertension in past year

	"Very confident" self-management (n = 2045)	High blood pressure at last visit (n = 2273)	ED visit or hospitalization (n = 2045)
Sample size	OR (95% CI)		
Race/ethnicity (ref: non-Hispanic White)			
Hispanic/Latino	0.76 (0.41,1.41)	0.68 (0.40,1.18)	1.78 (0.60,5.33)
Non-Hispanic African American	0.76 (0.46,1.24)	0.36*** (0.21,0.60)	3.61*** (1.88,6.91)
Non-Hispanic Asian American	0.49 (0.14,1.76)	0.40* (0.16,0.97)	2.49 (0.38,16.13)
Non-Hispanic American Indian/Alaska Native	0.69 (0.33,1.43)	0.68 (0.38,1.22)	5.31*** (2.13,13.20)
Non-Hispanic other	0.87 (0.22,3.39)	1.43 (0.38,5.41)	0.30 (0.06,1.49)
Predisposing determinants			
Age (ref: 18-44)			
45-64 y	1.20 (0.80,1.80)	0.97 (0.65,1.45)	0.60 (0.35,1.03)
65+ y	1.29 (0.69,2.41)	1.02 (0.60,1.75)	0.74 (0.31,1.78)
Male (vs female)	1.28 (0.88,1.84)	0.74 (0.53,1.04)	0.88 (0.54,1.44)
US born (vs not)	1.06 (0.61,1.85)	0.77 (0.47,1.27)	0.68 (0.28,1.65)
High school graduate (vs less)	1.06 (0.71,1.59)	0.95 (0.67,1.36)	1.12 (0.53,2.37)
Employed (vs not)	1.38 (0.88,2.15)	0.89 (0.64,1.22)	0.78 (0.47,1.31)
Enabling determinants			
Currently insured (vs not)	1.13 (0.76,1.67)	1.35 (0.92,1.99)	0.91 (0.51,1.62)
Unmet medical need in past year (vs not)	0.99 (0.52,1.90)	0.95 (0.48,1.87)	1.26 (0.52,3.05)
Delayed medical care in past year (vs not)	0.77 (0.43,1.40)	0.63 (0.37,1.06)	0.99 (0.47,2.08)
Need determinants			
Self-reported fair/poor health status (vs better)	0.40*** (0.30,0.53)	0.65* (0.46,0.92)	1.16 (0.66,2.04)
Hypercholesterolemia	0.89 (0.64,1.22)	1.18 (0.85,1.63)	2.31** (1.37,3.88)
Diabetes	1.34 (0.95,1.88)	0.69* (0.49,0.99)	0.56 (0.31,1.03)
Cardiovascular disease	0.91 (0.56,1.50)	1.08 (0.72,1.61)	2.68** (1.27,5.63)
Body mass index (ref: BMI 0-24.99)			
Overweight (BMI 25.0-29.99)	2.10** (1.23,3.59)	0.72 (0.45,1.15)	0.94 (0.50,1.76)
Obese (BMI 30.0 or higher)	1.22 (0.74,2.00)	0.62* (0.41,0.93)	0.70 (0.35,1.39)
Current smoker	0.97 (0.63,1.49)	1.04 (0.72,1.51)	0.93 (0.60,1.44)

BMI, body mass index.

\* $P < 0.05$ .\*\* $P < 0.01$ .\*\*\* $P < 0.001$ .

responses are based on self-report and are subject to recall and acquiescence biases. For example, patients may not remember or misreport past hypertension diagnoses or counseling. Conversely, patients who do remember their hypertension diagnosis may have greater disease severity and report higher rates of adherence when questioned. Therefore, patients may report high rates of adherence to provider recommendations and confidence in ability to manage hypertension yet their hypertension may not be controlled.<sup>47,48</sup> Our sample included all individuals who were ever told they had hypertension and we could not exclude those who no longer had this condition. Thus, we may have over- or underestimated the association of provider interventions or patient adherence.

Despite these limitations, our study provides insight to hypertension care of some of the most vulnerable populations in the United States and assesses racial/ethnic disparities among populations such as non-Hispanic Asian Americans and non-Hispanic AIAN where previous studies have focused on non-Hispanic White and non-Hispanic African American populations.<sup>49</sup>

Our study findings suggest that the equitable delivery of hypertension management in health centers may contribute to the reduction of racial/ethnic disparities in cardiovascular disease morbidity and mortality. Furthermore, policies that promote the expansion of access to primary care services, such as those provided by health centers, may help curb future costs associated



with complications of hypertension by avoiding unnecessary hospitalizations. Addressing chronic health conditions, like hypertension, in health centers will become increasingly relevant as the proportion of older Americans with one or more chronic conditions continues to grow.<sup>50</sup>

## CONFLICT OF INTEREST

The authors report no specific funding in relation to this research and no conflicts of interest to disclose.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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