

# ASSOCIATION OF PERCEIVED STRESS AND DISCRIMINATION ON MEDICATION ADHERENCE AMONG DIVERSE PATIENTS WITH UNCONTROLLED HYPERTENSION

Carmen Alvarez, PhD, CRNP<sup>1,2</sup>; Anika L. Hines, PhD, MPH<sup>3</sup>; Kathryn A. Carson, ScM<sup>2,4</sup>; Nadia Andrade, APRN<sup>1</sup>; Chidinma A. Ibe, PhD<sup>2,4</sup>; Jill A. Marsteller, PhD<sup>5</sup>; Lisa A. Cooper, MD, MPH<sup>1,2,4,6</sup> for the RICH LIFE Project Investigators

**Background:** Uncontrolled hypertension is a significant risk factor for cardiovascular morbidity and mortality. In the United States, many patients remain uncontrolled, in part, due to poor medication adherence. Efforts to improve hypertension control include not only attending to medical management of the disease but also the social determinants of health, which impact medication adherence, and ultimately blood pressure control.

**Purpose:** To determine which social determinants – health care access or community and social stressors – explain medication adherence.

**Methods:** In this cross-sectional analysis, we used baseline data (N=1820, collected August 2017 to October 2019) from a pragmatic trial, which compares the effectiveness of a multi-level intervention including collaborative care and a stepped approach with enhanced standard of care for improving blood pressure. We used logistic regression analyses to examine the association between patient experiences of care and community and social stressors with medication adherence.

**Results:** The participants represented a diverse sample: mean age of 60 years; 59% female; 57.3% Black, 9.6% Hispanic, and 33.2% White. All participants had a blood pressure reading  $\geq 140/90$  mm Hg (mean blood pressure – 152/85 mm Hg). Half of the participants reported some level of non-adherence to medication. Regression analysis showed that, compared with Whites, Blacks (AOR .47; 95% CIs: .37-.60,  $P < .001$ ) and Hispanics (AOR .48; 95% CIs: .32-.73,  $P < .001$ ) were less likely to report medication adherence. Also part-time workers (AOR .57; 95% CIs: .38-.86,  $P < .05$ ), and those who reported greater perceived stress (AOR .94; 95% CIs: .91 – .98,  $P < .001$ ) and everyday discrimination (AOR .73; 95% CIs: .59 – .89;  $P < .001$ ) had lower odds

## INTRODUCTION

Uncontrolled hypertension remains a significant public health burden. In the United States, an estimated one in three adults has hypertension; of these, the majority are uncontrolled (51.7%).<sup>1</sup> Uncontrolled blood pressure also disproportionately affects racial/ethnic minorities. Non-Hispanic Blacks not only have

a higher prevalence of hypertension compared with non-Hispanic Whites (40.3% to 27.8%), but they are also less likely to be controlled.<sup>2</sup> Blacks/African Americans are also disproportionately affected by the sequelae of uncontrolled hypertension, experiencing earlier onset of stroke and greater risk for renal disease.<sup>2</sup> Although Hispanics are as likely as non-Hispanic Whites to have hypertension, they

of medication adherence. Among Blacks, greater perceived stress (AOR .93; 95% CIs: .88-.98,  $P < .001$ ) and everyday discrimination (AOR .63; 95% CIs: .49 - .82,  $P < .005$ ) were negatively associated with medication adherence. Among Hispanics, greater report of everyday discrimination (AOR .36; 95% CIs: .14 – .89,  $P < .005$ ) was associated with lower odds of medication adherence. Among Whites, the negative effect of perceived stress on medication adherence was attenuated by emotional support.

**Conclusions:** Using the social determinants of health framework, we identified associations between stress, everyday discrimination and medication adherence among non-Hispanic Blacks and Hispanics that were independent of health status and other social determinants. Programs to enhance self-management for African American and Hispanic patients with uncontrolled blood pressure should include a specific focus on addressing social stressors. *Ethn Dis.* 2021;31(1):97-108; doi:10.18865/ed.31.1.97

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<sup>1</sup> Johns Hopkins University School of Nursing, Baltimore, MD

<sup>2</sup> Johns Hopkins Center for Health Equity, Baltimore, MD

<sup>3</sup> Virginia Commonwealth University School of Medicine, Department of Health Behavior and Policy, Richmond, VA

<sup>4</sup> Johns Hopkins University School of Medicine, Department of Medicine, Division of General Internal Medicine, Baltimore, MD

<sup>5</sup> Johns Hopkins Bloomberg School of Public Health, Department of Health Policy and Management, Baltimore, MD

<sup>6</sup> Johns Hopkins Bloomberg School of Public Health, Department of Health, Behavior and Society, Baltimore, MD

Authors' note: C Alvarez and A Hines are co-first authors of this article

Address correspondence to Carmen Alvarez, PhD, Johns Hopkins University School of Nursing, 525 N Wolfe Street, Baltimore, MD 21205; calvare9@jhu.edu

are also less likely to be controlled.<sup>1,3</sup>

Medication adherence is one of the most important contributors to blood pressure control. A year after initiation of therapy, researchers estimate that less than half of patients are adherent.<sup>4</sup> This suboptimal adherence may partially explain the racial/ethnic disparities in hypertension control, as African Americans and Hispanics are less likely to adhere to antihypertensive therapy compared with non-Hispanic Whites.<sup>5,6</sup> These lower rates of medication adherence among racial/ethnic minority groups are much

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*We examined the association between community and social stressors and medication adherence within a diverse population of patients with uncontrolled blood pressure.*

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more complex than patient knowledge or preference; in fact patients with hypertension are often aware of the importance and need for medication adherence.<sup>7,8</sup> Further, adherence interventions that focus on education have not led to optimal blood pressure control.<sup>9,10</sup> Addressing these disparities in hypertension requires a more comprehensive understanding of the various predictors that most affect medication adherence for hypertension control.

The social determinants of health (SDOH) framework is a useful guide for considering the non-medical factors that impact medication adherence. There has been growing recognition that “the conditions in which people are born, grow, work, live and age...” most explain health behavior and health outcomes compared with access to clinical services.<sup>11,12</sup> The social determinants of health include factors such as economic stability, neighborhood and physical environment, education, food security, community and social contexts, and health care services.<sup>13</sup> Researchers have established some associations between sociodemographic factors, such as sex, socioeconomic status, and health literacy and medication non-adherence among hypertensive patients.<sup>14,15</sup> Researchers have also established associations between patient-provider relationship characteristics (such as trust<sup>16</sup> and shared decision-making<sup>17</sup>) and medication adherence.

Less explored in antihypertension medication adherence is its association with community and social stressors (ie, racial discrimination, perceived stress, and neighborhood disorder). Negative associations between perceived discrimination and medication adherence have been identified among African Americans<sup>18,19</sup>; however, these associations were no longer significant after accounting for stress, depression, and trust. Among community-dwelling African Americans with hypertension, neighborhood violence was reported as a barrier to medication adherence.<sup>8</sup> Some social determinants positively influence medication adherence. For example, instrumental and emotional social support have been associated with medication adherence.<sup>8</sup>

Also, patient-provider communication in which providers discuss patients' social needs, such as housing, are associated with adherence.<sup>20</sup> In keeping with value-based care and improving population health, better understanding of non-medical factors that impact patient behavior can inform patient counseling and community services.

Guided by the SDOH framework,<sup>13</sup> we examined the association between community and social stressors and medication adherence within a diverse population of patients with uncontrolled blood pressure. Given that patients with uncontrolled hypertension represent a higher proportion of those non-adherent to medications (83.7%), we aimed to fill gaps in understanding health behaviors of this particularly vulnerable population.<sup>21</sup> We hypothesized that all community and social stressors would be negatively associated with medication adherence, and that social support and positive patient experiences with care would partially explain these associations.

## **METHODS**

### **Study Overview and Data Source**

The data for this study come from baseline interviews of patients enrolled in the RICH LIFE (Reducing Inequities in Care of Hypertension: Lifestyle Improvement for Everyone) Project,<sup>22</sup> in which we are comparing the effectiveness of enhanced standard of care with a clinic-based multilevel intervention. The intensive intervention includes provision of patient-centered care and behavior change counseling by a nurse care manager and, if needed, a

community health worker, or a group of specialists to improve blood pressure control. The RICH LIFE Project includes partnerships with 30 clinical sites across Maryland and Pennsylvania, representing private clinics and federally qualified health centers (FQHCs). Given the focus on patients with hypertension, inclusion criteria included: 1) a diagnosis of hypertension with at least one other cardiovascular risk factor (coronary heart disease, diabetes mellitus, hyperlipidemia, current tobacco smoker, and/or diagnosis of depression); 2) a blood pressure reading  $\geq 140/90$  mm Hg at the last provider visit; 3) ages  $\geq 21$  years; and 4) non-Hispanic White, non-Hispanic African American, or Hispanic ethnicity.

The institutional review board at Johns Hopkins University approved this project and all procedures. Participant eligibility was determined using electronic medical records. Eligible participants received mailed invitations to participate in the project, along with a copy of oral consent. Those who were interested in participating were further screened, consented, and completed the baseline survey via phone from August 2017 to October 2019. Our sample included 1820 patients aged 22-99 years who, based on data from electronic medical records, were categorized as non-Hispanic Black or African American ( $n=1042$ ), non-Hispanic White ( $n=604$ ), or Hispanic ethnicity, regardless of race ( $n=174$ ).

## Measures

### Dependent Variable

Medication adherence was assessed using a 4-item medication adherence scale adapted from Morisky,

Green, and Levine.<sup>23</sup> The medication adherence scale included the items “Do you ever forget to take your blood pressure medicine?” “Do you ever choose not to take your blood pressure medicine for other reasons, such as the cost, it is inconvenient, you don’t think you need it, or you don’t think that it is helping?”, “Sometimes if you feel worse when you take your blood pressure medicine, do you stop taking it?”, and “When you feel better, do you sometimes stop taking your blood pressure medicine?” Response items were dichotomous: 1 = Yes, 0 = No. Items were summed for a total score; higher scores suggest poorer medication adherence. We then dichotomized scores into – non-adherent (total score  $\geq 1$ ) and adherent (total score = 0).

### Independent Variables

#### STRESSORS

Individual and community-related stressors included perceived stress, experiencing everyday discrimination, experiences of victimization, and neighborhood violence and disorder. The means for sum scores were calculated for all measures, and higher scores indicated greater perceived stress, discrimination, and community stressors. We assessed perceived stress with the 4-item, 5-point Likert (0 – never, 4 – very often) Perceived Stress Scale (PSS-4).<sup>24</sup> Items in this scale included questions about feelings in the last month, such as: “In the last month, how often have you felt that you were unable to control the important things in your life?” ( $\alpha=.75$ ). Everyday discrimination and other community stressors were assessed using previ-

ously adapted sub-scales.<sup>25</sup> Everyday discrimination was assessed with a 5-item, 5-point Likert scale (0 – never, 4 – at least once a week) that asked about the frequency of experiences such as being threatened or being treated with less courtesy or respect than other people ( $\alpha=.66$ ). A 5-item, 4-point Likert scale (0 – never, 3 – often) was used to assess community violence; items addressed frequency of violence in one’s neighborhood such as robberies and gang fights ( $\alpha=.82$ ). We used a similar scale (5-item, 4-point Likert scale: 0 – none, 3 – a lot) to assess community disorder; these items addressed quantity of disorder in one’s neighborhood such as seeing broken glass on streets, graffiti and people drinking alcohol in public spaces ( $\alpha=.83$ ). To assess for individual experiences with violence, we used the Total Victimization Scale (4-items, 0 – no, 1 – yes) which addressed experiences of being assaulted, robbed, and having property broken into or vandalized.

We also accounted for physical and mental health functioning using the Patient-Reported Outcomes Measurement Information System (PROMIS) Global-10 measure.<sup>26-28</sup> The Global-10 includes items such as: “In general, would you say your health is (5 = Excellent, 1 = Poor)” and “How often have you been bothered by emotional problems such as feeling anxious, depressed or irritable? (5 = Never, 1 = Always).” The health measures team calculated physical health functioning with four items that addressed: physical abilities; perceived physical health; pain and fatigue; mental health functioning was calculated

with items about: perceived mental health; quality of life; satisfaction with social relationships; and emotional problems. For both measures, higher scores indicated better physical and mental health functioning.

#### PATIENT EXPERIENCES OF CARE

We used two indicators to assess patient experiences of care: 1) the AHRQ Care Coordination Quality Measure for Primary Care (CCQM-PC)<sup>29</sup>: *“In the last 12 months, how often did your primary care provider or other primary care professionals in their office give you information about available community-based services to support your health such as support groups, classes, counselors, community recreation programs, or faith-based activities”* (1- never, 4- always); and 2) the Patient Assessment of Care for Chronic Conditions (PACIC-PLUS) (26 items) that included items about patient engagement behaviors from the provider,<sup>30</sup> for example: *“Over the past 6 months, when receiving medical care from my primary care provider for my high blood pressure, I was: Helped to make a treatment plan that I could do in my daily life”*, and *“I was: Given a copy of my treatment plan”* (1- almost never, 5 – almost always) ( $\alpha=.95$ ).

#### SOCIAL SUPPORT

The PROMIS measures for social support were used to assess emotional support. This was a 4-item measure that included statements such as, *“I have someone to confide in or talk to about myself or my problems”*, with a 5-point Likert response scale (0 – never, 4 – always). Higher scores indicated greater social support.

#### Covariates

Demographic information included: age, sex, race/ethnicity, marital status, educational attainment, employment, and health insurance.

#### Statistical Analyses

Analyses were conducted with IBM SPSS Statistics 25 software. Descriptive analyses were conducted for all measures. To evaluate differences by race/ethnicity, we conducted analysis of variance tests for continuous variables and  $\chi^2$  analyses for categorical variables. In order to build a parsimonious model, we first conducted bivariate analyses between the dependent variable, medication adherence, and our independent variables prior to conducting multivariable logistic regression analyses. Multivariable stepwise logistic regression models were estimated to examine whether patient experiences with care or community and social stressors explained more variance in medication adherence. Analyses were conducted with the total sample controlling for race/ethnicity, and then repeated stratified by race/ethnicity. Significance was set at  $P<.05$ .

## RESULTS

### Participants

Demographic characteristics, average blood pressure, average scores for community and social stressors, and frequency of adherence at baseline are displayed in Table 1 for the total sample and stratified by racial/ethnic group. Overall, the sample was predominantly Black, female, and per eligibility requirements, had uncontrolled blood pressure. Almost half of

the sample reported non-adherence to their medications. Statistically significant differences between racial/ethnic groups were detected for almost all variables. Non-Hispanic Blacks and Hispanics were significantly younger than Non-Hispanic White participants. More White participants reported being married, college-educated, and retired. Compared with Whites and Blacks, Hispanics reported significantly poorer physical health functioning; compared with Whites, Hispanics reported significantly poorer mental health functioning. Also, compared with Whites, Blacks and Hispanics reported less emotional support. Compared with Whites and Hispanics, Black participants had higher PACIC-PLUS scores, everyday discrimination, and community violence. Compared with Whites, Blacks and Hispanics reported more perceived stress and non-adherence to medications.

Table 2 displays bivariate relationships between medication adherence and covariate and independent variables. Medication adherence was associated with all variables except for sex and the indicators of patient experiences with care. Because these variables were not associated with medication adherence in bivariate analysis, they were not included in the multivariable regression models.

### Stressors and Medication Adherence

Table 3 displays results from the multivariate logistic regression model examining the association between the various interpersonal and community stressors and medication adherence. Model 1, unadjusted for sociodemographic and independent



**Table 1. Demographic characteristics of sample**

	Total, n = 1820	Black, n = 1042	White, n = 604	Hispanic, n = 174
Age <sup>a</sup>	60.4 (11.9)	58.0 (11.3)	65.2 (11.7)	58.0 (11.5)
Female	59.4%	63.8%	51.5%	60.3%
Marital status <sup>a</sup>				
Married/cohabitating	45.1%	35.5%	60.1%	50.9%
Widowed	11.2%	10.3%	13.7%	8.1%
Divorced/separated	22.1%	24.0%	19.0%	22.0%
Never married	21.5%	30.3%	7.1%	19.1%
Education <sup>a</sup>				
< High school	18.5%	20.7%	6.0%	49.1%
High school graduate	47.4%	51.7%	43.3%	36.8%
Associates degree	12.0%	11.1%	15.3%	6.4%
Bachelors or higher	22.0%	16.5%	35.5%	7.6%
Employment <sup>a</sup>				
Full-time	31.2%	30.8%	32.0%	30.5%
Part-time	10.1%	9.7%	9.8%	13.8%
Unemployed or looking for work	6.5%	8.3%	3.8%	5.2%
Not working for health reasons	19.9%	24.6%	9.3%	29.3%
Retired	32.3%	26.6%	45.1%	21.3%
Health insurance coverage <sup>a</sup>				
Private	24.5%	24.1%	25.0%	25.3%
Medicare	24.8%	21.0%	32.2%	22.0%
Medicaid	22.8%	32.3%	7.3%	19.3%
Military (Tricare/VA/CHAMP-VA)	12.6%	7.9%	22.5%	4.7%
State and other government plans	15.3%	14.7%	13.0%	28.7%
Blood pressure				
Systolic <sup>a</sup>	152.3 (12.1)	153.5 (13.0)	150.4 (10.7)	151.2 (10.5)
Diastolic <sup>a</sup>	85.5 (12.3)	87.9 (12.3)	81.4 (11.6)	85.1 (11.2)
Health status				
Physical health functioning <sup>a</sup>	13.6 (3.2)	13.3 (3.2)	14.2 (2.9)	12.7 (3.4)
Mental health functioning <sup>a</sup>	13.7 (3.4)	13.4 (3.4)	14.4 (3.3)	13.1 (3.3)
Patient experiences with care				
Patient assessment of care for chronic conditions (PACIC-PLUS) <sup>a</sup>	3.2 (1.0)	3.2 (1.0)	3.1 (0.9)	3.1 (1.0)
AHRQ Care Coordination Quality <sup>a</sup>	1.6 (1.01)	1.7 (1.06)	1.5 (0.92)	1.5 (1.0)
Social support				
Emotional <sup>a</sup>	17.6 (3.67)	17.4 (3.88)	18.1 (3.00)	17.0 (4.25)
Stressors				
Perceived stress <sup>a</sup>	4.1 (3.5)	4.1 (3.5)	3.7 (3.48)	4.8 (3.6)
Discrimination <sup>a</sup>	.4 (.6)	.5 (.6)	.4 (.6)	.3 (.5)
Community violence <sup>a</sup>	1.3 (2.6)	1.7 (3.0)	.7 (1.8)	.7 (1.8)
Community disorder <sup>a</sup>	2.7 (3.6)	3.4 (3.9)	1.6 (2.5)	2.6 (3.2)
Total victimization	.5 (.8)	.6 (.9)	.5 (.8)	.4 (.8)
Medication adherence <sup>a</sup>				
Not adherent	49.9%	57.8%	33.4%	58.2%

Data are M (SD) or %.

a. P < .001 for differences between racial/ethnic groups

variables showed that greater report of perceived stress and everyday discrimination was associated with lower odds of medication adherence. In Model 2, these negative relationships remained

after adjusting for sociodemographic factors, health status, and emotional support where greater report of perceived stress (AOR = .94; 95% CI = .91 – .98) and discrimination (AOR =

.73; 95% CI = .59 – .89) were associated with lower odds of medication adherence. Also, older participants (AOR = 1.03; 95% CI = 1.02 – 1.04) had significantly higher odds of being

**Table 2. Bivariate analyses of medication adherence with covariate and independent variables**

	Adherent	Not adherent
Age <sup>a</sup>	63.54 (11.69)	57.49 (11.52)
Sex		
Female	29.4%	30.3%
Male	20.8%	19.6%
Marital status <sup>a</sup>		
Married/cohabitating	23.8%	21.3%
Widowed	6.7%	4.6%
Divorced/separated	10.7%	11.3%
Never married	9.0%	12.6%
Education <sup>a</sup>		
<High school	7.8%	11.0%
High school graduate	23.2%	24.6%
Associates degree	6.1%	6.0%
Bachelors or higher	12.9%	8.4%
Employment <sup>a</sup>		
Full-time	15.3%	15.5%
Part-time	4.4%	5.6%
Unemployed or looking for work	2.6%	4.0%
Not working for health reasons	8.0%	12.2%
Retired	19.8%	12.6%
Health insurance coverage <sup>a</sup>		
Private	11.4%	12.9%
Medicare	15.1%	10.3%
Medicaid	9.1%	13.6%
Military (Tricare/VA/CHAMP-VA)	7.7%	4.5%
State and other government plans	7.1%	8.1%
Health status <sup>a</sup>		
Physical health functioning	13.97 (3.08)	13.05 (3.18)
Mental health functioning	14.36 (3.16)	13.00 (3.41)
Patient experiences with care		
Patient Assessment of Care for Chronic Conditions (PACIC-PLUS)	3.20 (1.01)	3.13 (1.06)
AHRQ Care Coordination Quality	1.61 (1.00)	1.61 (1.01)
Emotional support <sup>a</sup>	17.99 (3.29)	17.18 (3.98)
Stressors		
Perceived stress <sup>a</sup>	3.35 (3.18)	4.80 (3.73)
Discrimination <sup>a</sup>	.31 (.49)	.52 (.66)
Community violence <sup>a</sup>	.91 (2.24)	1.58 (2.85)
Community disorder <sup>a</sup>	2.22 (3.16)	3.26 (3.88)
Total victimization <sup>a</sup>	.47 (.77)	.59 (.89)

Data are M (SD) or %.

a. P<.01.

adherent to their medications. Compared with White participants, Black (AOR = .47; 95% CI = .37 – .60) and Hispanic (AOR = .48; 95% CI = .32 – .73) participants had significantly lower odds of medication adherence. The unadjusted model explained 12% - 16% of the variance in medication

adherence; the complete model explained 13% – 18% of the variance.

We then examined the association between the various stressors and medication adherence in three models stratified by race/ethnicity (Table 4). Among Black participants, older age (AOR = 1.02; 95%

CI = 1.00 – 1.04) and greater mental health functioning (AOR = 1.08; 95% CI = 1.02 – 1.14) were associated with greater odds of medication adherence. Greater report of perceived stress (AOR = .93; 95% CI = .88 – .98) and discrimination (AOR = .63; 95% CI = .49 – 0.82)

**Table 3. Logistic regression models of perceived stress, discrimination, victimization, and community violence on medication adherence, all races and ethnicities**

	Model 1		Model 2 <sup>b</sup>	
	AOR	95% CI	AOR	95% CI
Interpersonal stressors				
Perceived stress <sup>a</sup>	.91	.88 – .94	.94	.91 – .98
Discrimination <sup>a</sup>	.68	.56 – .82	.73	.59 – .89
Total victimization	.96	.85 – 1.09	.91	.80 – 1.04
Community stressors				
Community violence	.97	.91 – 1.02	.97	.92 – 1.03
Community disorder	.97	.94 – 1.00	1.00	.97 – 1.05
Age			1.03	1.02 – 1.04
Race/ethnicity				
Black <sup>a</sup>			.47	.37 – .60
Hispanic <sup>a</sup>			.48	.32 – .73
White			Ref	Ref
Education				
< High school education			.89	.66 – 1.21
High school graduate			Ref	Ref
Associates/community college/technical degree			.99	.71 – 1.38
Bachelor's degree or higher			1.10	.83 – 1.47
Employment				
Full-time			Ref	Ref
Part-time <sup>a</sup>			.57	.38 – .86
Unemployed			.96	.60 – 1.53
Not working because of health reasons			.95	.67 – 1.35
Retired			.77	.55 – 1.09
Health				
Physical health functioning			1.02	.97 – 1.06
Mental health functioning			1.04	.99 – 1.09
Health insurance coverage				
Private			Ref	Ref
Medicare			1.32	.95 – 1.84
Medicaid			1.17	.84 – 1.64
Military (Tricare/VA/CHAMP-VA)			1.09	.73 – 1.63
State and other government plans			1.18	.84 – 1.66
Emotional support			1.00	.97 – 1.03
Cox & Snell <i>R</i> <sup>2</sup>	.12			.13
Nagelkerke <i>R</i> <sup>2</sup>	.16			.18

a.  $P < .01$ 

b. All variables shown in the table are included in Model 2.

were associated with lower odds of medication adherence, even after adjusting for emotional support and other sociodemographic factors (education, employment, health insurance). For the same model among White participants, older age (AOR = 1.05; 95% CI = 1.02 – 1.07) and having a bachelor's degree or higher (AOR = 1.73; 95% CI = 1.10 –

2.73) were associated with greater odds of medication adherence. Also among Whites, compared with those who were employed full-time, part-time workers (AOR = .35; 95% CI = .19 – .74) and retirees (AOR = .52; 95% CI = .28 – .95) had lower odds of medication adherence. Greater report of perceived stress was also associated with lower odds of medi-

cation adherence; however, this relationship was no longer significant after adjusting for sociodemographic factors, physical and mental health functioning, and emotional support.

Given the smaller sample of Hispanics, we used a more parsimonious model to examine the relationships between sociodemographic factors, health status, emotional support, and

**Table 4. Logistic regression models of perceived stress and discrimination, on medication adherence by race/ethnicity**

	Blacks		Whites		Hispanic	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
<b>Interpersonal Stressors</b>						
Perceived Stress	.89 <sup>a</sup> (.86 – .94)	.93 <sup>a</sup> (.88 – .98)	0.91 <sup>a</sup> (.86 – 0.96)	.94 (.87 – 1.00)	.97 (.87 – 1.07)	.96 (.85 – 1.10)
Discrimination	.57 <sup>a</sup> (.47 – .77)	.63 <sup>a</sup> (.49 – .82)	.89 (.64 – 1.25)	1.05 (.73 – 1.52)	.33 <sup>a</sup> (.15 – .75)	.36 <sup>a</sup> (.14 – .89)
Age		1.02 <sup>a</sup> (1.00 – 1.04)		1.05 <sup>a</sup> (1.02 – 1.07)		1.04 <sup>a</sup> (1.00 – 1.08)
<b>Education</b>						
< High school education		.89 (.62 – 1.29)		.76 (.35 – 1.64)		.96 (.46 – 1.99)
High school graduate		Ref		Ref		Ref
Associates/community college/ technical degree		.72 (.46 – 1.13)		1.60 (.91 – 2.80)		Ref
Bachelor's degree or higher		.83 (.55 – 1.25)		1.73 <sup>a</sup> (1.10 – 2.73)		Ref
<b>Employment</b>						
Full-time		Ref		Ref		1.19 (.48 – 2.91)
Part-time		.63 (.37 – 1.08)		.35 <sup>a</sup> (.19 – 0.74)		Ref
Unemployed		1.07 (.61 – 1.87)		.52 (.18 – 1.43)		Ref
Not working because of health reasons		1.03 (.68 – 1.60)		.84 (.38 – 1.83)		Ref
Retired		.92 (.59 – 1.43)		.52 <sup>a</sup> (.28 – .95)		Ref
<b>Insurance</b>						
Private		Ref				1.11 (.48 – 2.55)
Medicare		1.25 (.80 – 1.96)		1.58 <sup>a</sup> (.86 – 2.91)		Ref
Medicaid		1.24 (.83 – 1.85)		.83 <sup>a</sup> (.37 – 1.89)		Ref
Military (Tricare/VA/CHAMP-VA)		1.24 (.69 – 2.23)		1.17 <sup>a</sup> (.62 – 2.19)		Ref
State and other government plans		1.16 (.74 – 1.84)		1.14 <sup>a</sup> (.60 – 2.18)		Ref
<b>Health</b>						
Physical health functioning		1.01 (.95 – 1.06)		1.00 <sup>a</sup> (.92 – 1.09)		1.03 (.89 – 1.20)
Mental health functioning		1.08 (1.02 – 1.14)		.97 <sup>a</sup> (.90 – 1.07)		.99 (.83 – 1.17)
Emotional support		1.00 (.96 – 1.04)		1.05 <sup>a</sup> (.98 – 1.12)		.96 (.87 – 1.05)
Cox & Snell R2	.069	.10	.027	.104	.055	.105
Nagelkerke R2	.093	.135	.038	.145	.074	.141

AOR (95% CI) unless specified otherwise.

<sup>a</sup> P < .01.

All of the variables in the table are included in Model 2.

interpersonal stressors and medication adherence. Among Hispanics, older age (AOR = 1.04; 95% CI = 1.00 – 1.08) was associated with increased odds of medication adher-

ence, and everyday discrimination (AOR = .36; 95% CI = .14 – .89) was negatively associated with medication adherence, even after adjusting for the other variables. The unadjusted

models explained the most amount of variance in medication adherence among Blacks (6.9% – 9.3%) and Hispanics (5.5% – 7.4%), compared with Whites (2.7 – 3.8%). The fully



adjusted models explained roughly the same amount of variance for medication adherence for each race/ethnicity group, approximately 10% – 14%.

## DISCUSSION

In this diverse sample of patients with uncontrolled blood pressure, perceived stress and everyday discrimination were negatively associated with medication adherence. Other researchers have also identified negative relationships between discrimination and medication adherence<sup>18,19</sup>; however, unlike prior work, the negative relationships we identified remained even after adjusting for mental health functioning and social support. Another novelty with our findings is the racial/ethnic differences in the relationship between stressors and medication adherence. Among Whites, the negative relationship between perceived stress and medication adherence was attenuated by emotional support. However, among Blacks, the negative relationship between perceived stress and discrimination remained, even after adjusting for emotional support and other sociodemographic factors. Similarly, among Hispanics, everyday discrimination remained a negative predictor of medication adherence. These findings underscore the need to address psychosocial stressors among racial/ethnic populations with uncontrolled hypertension.

Community-related stressors were not associated with medication adherence in our models that accounted for interpersonal stressors. Also, when entered in a model without interpersonal stressors and adjusting for sociodemographic factors, health status,

and emotional support, community-related stressors (community violence and disorder) were not associated with medication adherence (data not shown). As suggested in prior work,<sup>8</sup> community stressors may have more of an indirect impact on medication adherence. An alternative explanation is that the physical presence of community stressors (eg, violence, disorder) is dampened after accounting for individual lived experiences within those contexts, for example, feeling disrespected, criminalized, and harassed. Community stress and disorder were negatively associated with medication adherence before interpersonal stressors—perceived stress and experiences with racial discrimination—were introduced to the model (data not shown).

Black and Hispanic patients' report of greater community disorder and violence may have been encapsulated in their overall perceptions of stress and discrimination, thereby contributing to the null association between community attributes and medication adherence as well as racial/ethnic differences in these associations. Race/ethnicity are social constructs; given that Blacks and Hispanics reported residing in more stressful environments, community stressors may still be relevant determinants of medication adherence, as well as other behaviors important for blood pressure control such as physical activity. More research is needed to understand multi-level exposures to and experiences of stress among patients with hypertension.

In this study, aspects of the patient experience, including being provided choices, engagement in treatment planning, and goal setting were not associated with greater medication adher-

ence. There are a few interpretations of this finding. First, consistent with the SDOH framework,<sup>13</sup> experiences outside of the health system, including patients' social and physical community environments, may be more salient predictors of medication adherence than what happens in individual health care encounters. Alternatively, our measurement of patient experience—despite detailing the mechanics of the encounter—did not address

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*In this diverse sample of patients with uncontrolled blood pressure, perceived stress and everyday discrimination were negatively associated with medication adherence.*

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psychosocial components noted to be of value to minority patients, including trust in physicians and respectful treatment by physicians. Previous work evaluating patient-provider communication about treatment among African American patients with depression in the primary setting found that measures of patient-centered communication were associated with patient ratings of care.<sup>31</sup> In patient-provider interactions where biomedical and procedural talk exceeded psychosocial and socioemotional exchange, it was seemingly more important to engage patients regarding lifestyle, coping strategies, cultural beliefs, and treatment concerns to

achieve mutual respect.<sup>31</sup> This suggests that consideration of relational aspects of the health care interaction may be emphasized among minority patients and African Americans, in particular.

In this way, effective communication in the clinical encounter entails clinicians drawing in discussion on patients' experiences of social determinants. Several studies document the relationship of patient-provider communication with adherence among hypertensive patients. Additionally, trust in one's physician has been identified as a mediator of the relationship between perceived discrimination and medication adherence among African Americans with hypertension.<sup>19</sup> Taken together—a hybrid explanation—patient behaviors, such as medication adherence, point back to patients' lived experiences in the context of community structures, including and external to health care. When placed in the same model, the contributing effects of each type of structure on multiple levels may be difficult to tease out due to the holistic (and uncompartamentalized) experience of patient reporting.

Specific to Hispanics in this sample, although they reported higher levels of perceived stress compared with non-Hispanics, perceived stress was not associated with medication adherence while everyday discrimination was independently associated with medication adherence. Even in bivariate analyses (data not shown) perceived stress among Hispanics was not associated with medication adherence. The relationship between these variables may be indirect and not captured with our variables. Hall and others<sup>7</sup> also did not find a relationship between perceived stress and medication adher-

ence among Hispanic farmworkers.

Antihypertension medication adherence has not been well explored among Hispanics; more work is needed to understand how psychosocial stressors such as discrimination may impact health behavior for hypertension control in this population. We are not aware of other studies that have identified discrimination as a determinant of medication adherence among Hispanics. This is an important finding for both Hispanics and non-Hispanic Blacks; knowing that feelings of discrimination can impact critical health behaviors could motivate patients to identify adaptive coping mechanisms to support optimal psychosocial well-being and hypertension control.

From a clinical perspective, our findings highlight the need for members of the health care team to inquire about psychosocial stress, including experiences of discrimination, when providing care to ethnic minority patients, and offer support, particularly those who report non-adherence. Consideration of these factors may contextualize patients' health behaviors and provide a foundation for informed patient engagement about treatment. Multiple patient-level strategies have demonstrated effectiveness for medication adherence, particularly engaging patients through an array of approaches such as behavioral counseling and motivational interviewing.<sup>32,33</sup> Also, interventions/practices initiated by health systems and payers, such as simplified medication regimens, 90-day prescriptions, low or no-copayment, and use of mail-order pharmacies<sup>34</sup> support medication adherence. Making these options available to all patients—particularly underserved groups and patients of color—could

contribute to medication adherence.

Our findings also highlight the importance of stress and discrimination on health behavior, particularly for Blacks/African Americans and Hispanics. Addressing these issues require structural changes beyond the health system. For example, Bailey and others<sup>35</sup> highlight the potential of “Purpose Built Communities Initiatives” for not only revitalizing deprived neighborhoods, but also increasing accessibility to quality affordable housing, early childhood to higher education, and employment. These opportunities are catalyzed by multi-sectoral investment and positively impact SDOH (ie, education, economic stability, neighborhood and physical environment). Although the evidence for the benefits of these initiatives on health and discrimination are pending, these initiatives target the SDOH that are known to impact health behaviors and well-being. Given that dilapidated and deprived neighborhoods are often the result of structural inequities and racism, direct investment for improving these spaces, in part, is movement toward addressing these injustices.

## **Study Strengths and Limitations**

The analysis presented in this study is cross-sectional and is from a sample of patients already engaged in primary care with health insurance, and those who consented to participate in a clinical trial; therefore, we interpret our findings with caution and do not suggest causality in relationships. Nonetheless, we acknowledge multiple strengths. Our sample represents diversity not just in race/ethnicity but also in socioeconomic status and clinic type. The study used a pragmatic ap-

proach to patient recruitment. This relatively large and diverse sample with uncontrolled hypertension provided the opportunity for disaggregated analyses and identification of significant predictors of medication adherence for each group. Moreover, given the growing focus on population health, it is important to identify how the various SDOH may contribute to health behaviors in different groups, particularly those with poorer outcomes.

## CONCLUSIONS

In summary, using the SDOH framework, we identified associations between stress, everyday discrimination and medication adherence that were independent of health status and other social determinants among non-Hispanic Blacks and Hispanics. For non-Hispanic Whites, indicators of economic stability (employment) and education were associated with medication adherence independent of health status and other social determinants. Our clinical trial, which examines the effectiveness of a patient-centered intervention including the use of behavioral counseling, motivational interviewing, and a focus on addressing social needs, will allow us to learn whether such approaches will attenuate the effects of perceived stress and discrimination on medication adherence among non-Hispanic Blacks and Hispanics and reduce disparities in hypertension control.

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## CONFLICT OF INTEREST

No conflicts of interest to report.

## AUTHOR CONTRIBUTIONS

Research concept and design: Alvarez, Hines, Marsteller, Cooper; Acquisition of data: Carson, Marsteller, Cooper; Data analysis and interpretation: Alvarez, Hines, Carson, Andrade; Manuscript draft: Alvarez, Hines, Ibe, Andrade; Statistical expertise: Alvarez, Hines, Carson; Acquisition of funding: Marsteller, Cooper; Administrative: Alvarez, Hines, Ibe, Andrade, Marsteller, Cooper; Supervision: Alvarez, Cooper

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