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Psychosocial Factors Contribute to Resting Blood Pressure in African Americans

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Abstract

Objectives—African Americans as a group have higher blood pressure than individuals of northern European ancestry (non-Hispanic Whites). We investigate whether psychosocial factors explain the resting blood pressure of healthy, community-dwelling African Americans in our study.

Participants—A convenience sample of self-reported normotensive African Americans aged 18–65 years who live in the North Carolina Triangle region.

Design—The study protocol consisted of three resting blood pressure sessions with assessment of the following psychosocial factors: anger expression, interpersonal support, anxiety, depression, hostility, active coping, and perceived racism. Additional clinical assessments were height, weight, waist girth, fasting glucose, insulin, triglycerides, and cholesterol.

Results—Resting systolic blood pressure was positively associated with male sex ($P < .001$) and positively correlated with age ($P < .0001$), waist girth ($P < .0001$), body mass index ($P = .023$), and a Cook Medley Hostility subscale identified as aggressive responding ($P = .031$). Mean arterial pressure was positively correlated with age ($P < .0001$), waist girth ($P = .0041$), Spielberger Anger Expression subscale anger control ($P = .023$), and aggressive responding ($P = .020$).

Conclusions—Anger and hostility are significantly associated with resting blood pressure and may modulate behavioral and traditional (biologic) risk factors that determine cardiovascular physiology.

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Keywords

Hypertension; Psychosocial Factors; Resting Blood Pressure; African Americans; Health Disparity

Introduction

Cardiovascular disease, including stroke, myocardial infarction, and atherosclerotic vascular disease, is the leading cause of morbidity and mortality in Western society and disproportionately affects the African American community.¹⁻³ Essential hypertension, which is a significant risk factor for stroke, myocardial infarction, and renal failure, is overrepresented in this minority population.⁴⁻⁶ Although mechanistic hypotheses have been proposed to explain the disproportionate prevalence of hypertension among African Americans,⁷ the etiology of essential hypertension in this population is incompletely understood.

Psychosocial factors have been suggested to play a key role in explaining the disparate prevalence of hypertension and cardiovascular disease.⁸ Some of the earliest work showing that socioeconomic status and active coping were associated with the increased prevalence of hypertension among African American was reported by James et al from a population of African Americans living in the northeastern part of North Carolina.⁸ Since these historical reports, other studies have supported this initial finding and included several other psychosocial factors such as attitudes toward (feeling supported and valued) and responses to (hostility, anger, depression, and anxiety) environmental stress.⁹ Individuals who score high for one or more psychosocial traits such as hostility, anxiety, depression, and stress are at increased risk for the development of cardiovascular disease.¹⁰

A recent hypothesis proposes that psychosocial factors explain the disparate prevalence of hypertension and stroke in African Americans. The mechanism could be a result of psychosocial factors that affect behavior (unhealthy diet, smoking, and lack of exercise) or physiologic processes such as the neuroendocrine system's regulation of blood pressure.¹¹ Psychosocial factors also include environmental stress such as racism; discrimination; smoking; traditional high-salt, high-fat southern diet; and the response to stressors, including active coping, anger, and hostility.

Our study examines resting blood pressure, psychosocial measures, and clinical measures in a group of African Americans living in the Triangle region of North Carolina. The North Carolina Triangle region is in the stroke belt (ie, a geographic region with a high occurrence of stroke).¹⁵

Methods

A convenience sample of 176 persons (63 men, 113 women) of self-reported African descent were recruited by fliers on campus. Entry criteria were age 18–65 years; residing in surrounding North Carolina Triangle regions of Durham, Orange, and Wake Counties; having no known (self-reported) cardiovascular disease; and not taking any antihypertensive

medication. Informed consent was obtained for each participant in accordance with North Carolina Central University institutional review board approval and federal guidelines.

Study participants were scheduled at either 9 am or 1 pm for the three-hour study protocol. Trained staff measured blood pressure with a GE Dinamap Pro 100 automatic sphygmomanometer and a cuff size appropriate for the body size. Each participant was allowed five minutes to sit quietly before taking the first resting blood pressure. The instrument was set to make measurements every minute for five minutes. In the second resting session, measurements were taken every minute for 10 minutes, while the third session was similar to the first session, ie, measurements were made every minute for five minutes. The instrument measured systolic and diastolic blood pressure (SBP, DBP), heart rate, and mean arterial pressure (MAP).

Psychosocial phenotypes were assessed by using the following validated self-report instruments: chronic exposure to racism was evaluated with the Perceived Racism Scale;¹⁶ social support with the Interpersonal Support Evaluation List;¹⁴ hostility with Barefoot's version of the Cook Medley Hostility Scale;¹⁷ depression with the Beck Depression Index;¹⁸ active coping with John Henry Active Coping;¹⁹ and anger with Spielberger Anger Expression.²⁰ We also assessed the level of anxiety with Spielberger's State-Trait Anxiety Inventory.²¹

On the following day, each participant reported to the student health center for collection of a fasting blood sample for serum isolation and DNA extraction. Lab Core analyzed serum samples for insulin, glucose, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, total cholesterol, and triglycerides. The homeostasis model assessment (HOMA) was calculated as an index of insulin sensitivity.²²

Statistical Analysis

Data were analyzed with SAS for Windows version 9.1.3 (SAS Institute, Inc, Cary, NC). Psychosocial scales and subscales used scoring protocols documented in prior research as indicated above and were confirmed with factor analysis. Cronbach α values $\geq .6$ were verified for each psychosocial scale with SAS PROC CORR. Data reduction for SBP, DBP, MAP, heart rate, and other clinical measures with multiple measurements used SAS PROC MEANS to calculate mean, standard deviation, standard error, median, and quartile scores as appropriate.

Examination of the PROC Univariate output indicated many of the clinical measures were not normally distributed. Since the data were not normally distributed, we used the Wilcoxon Mann-Whitney nonparametric test to assess sex differences in the clinical measures.

SAS PROC CORR calculated Pearson correlations between psychosocial and clinical measures or psychosocial and blood pressure measures. PROC REG with the stepwise option implemented the stepwise algorithm for variable selection of a multivariate model for predicting blood pressure. PROC GLM provided multivariate parameter estimates and confidence intervals. To assess the assumptions for the multivariate model, PROC

UNIVARIATE with the normal option plotted residuals and provided the Shapiro-Wilk statistic for normality.

Results

Sample Characteristics

The average age of our sample was 32 years (Table 1). Men had higher SBP, and women had a higher heart rate. Additionally, women had higher insulin levels and HOMA values, which suggests that the women in this group were more likely to be insulin resistant than were men. We observed no sex differences for the traditional metabolic syndrome risk factors.

Resting Blood Pressure and Metabolic Syndrome Risk Factors

We found a positive correlation of SBP, DBP, MAP, and heart rate with age. We did not find a correlation of resting blood pressure with any of the lipid variables (triglycerides, total cholesterol, LDL cholesterol, and HDL cholesterol). However, we did find that heart rate was positively correlated with insulin ($P<.0005$), glucose ($P<.0098$), and insulin resistance (HOMA) ($P<.0001$). Waist circumference was significantly correlated with SBP and MAP ($P<.0001$, $.0041$, respectively). Body mass index was significantly correlated with SBP ($P<.023$).

Resting Blood Pressure and Psychosocial Factors

Resting blood pressure parameters were analyzed for association with psychosocial factors such as hostility, anger, social support, depression, and active coping. Resting SBP, DBP, and MAP positively correlated with the Cook Medley Hostility aggressive responding subscale ($P<.031$, $.023$, and $.020$, respectively). Resting SBP, DBP, and MAP positively correlated with the anger control subscale of Spielberger Anger Expression ($P<.045$, $.048$, and $.023$, respectively). Resting blood pressure parameters were not significantly associated with active coping, depression, perceived racism, anxiety, or interpersonal support. (Table 3)

Significant parameters in the prediction of resting SBP were age, sex, and body mass index (Table 4). Psychosocial factors of aggressive responding and anger control were not significant, indicating a covariance with other parameters already in the model. Life-time perceived racism was a significant parameter. Verifications of the assumptions of multivariate modeling raised concerns because the residuals were not normally distributed. We attempted various transformations of the model parameters but did not find a regression model that adhered to the assumptions. Thus, we emphasize correlations rather than the results of the multivariate modeling.

Discussion

We found that psychosocial factors such as anger and hostility predict resting blood pressure in healthy, normotensive African Americans from the Triangle region of North Carolina in addition to traditional risk factors such as age, sex, and waist circumference. These data

demonstrate that responses to environmental stresses of everyday living play a substantial role in normal resting blood pressure regulation in young, healthy African Americans.

Our results are similar to those of previous studies of the association of psychosocial factors and resting blood pressure in educated African Americans. These studies also show a positive relationship between anger and blood pressure.^{9,23} Thus, our cohort appears to be representative of other comparable African American cohorts studied for psychosocial and blood pressure interaction. The interpretation of positive association of anger control and blood pressure has been explained as a result of a combination of fear of reprimand and guilt from feeling anger or hostile activation of the sympathetic nervous system.^{24,25} In contrast, anger expression also was positively correlated with blood pressure, as reported by others.^{23,26} However, some studies have found opposite associations.^{27,28} These disparate findings may be explained by the influence of social construct on expression of emotions;²⁵ that is, how the surrounding community or family views anger expression. The choice to control anger comes with consequences to health. More studies are needed to define the physiological pathways involved in the blood pressure response to anger

Hostility, as assessed by the aggressive responding subscale of the Cook-Medley scale, was positively associated with DBP and heart rate, while John Henryism showed no significant association. Others have also reported such an association of hostility and resting SBP, DBP, and total peripheral resistance but no association of John Henryism and resting blood pressure.[9,29,30] The failure to see an association of John Henryism and blood pressure may have a socioeconomic basis. In a previous study, higher blood pressure was associated with low education levels or low socioeconomic status combined with high John Henry Active Coping scores.⁸ Our cohort had a median education level of 14 years. In addition, many of our subjects were college students at the time of the study. Therefore, John Henryism may not play a role in blood pressure at this socioeconomic level. Unlike John Henryism, however, hostility may be independent of socioeconomic status.

I We did not find a correlation of perceived racism and resting blood pressure. Others have reported a lack of an association of racism and blood pressure.[31] Multivariate regression models (Table 2) identified chronic exposure to perceived racism as a contributing factor to resting blood pressure in this sample with a negative coefficient. Perhaps this finding is explained by the fact that most of the participants had lived in a homogenous cultural environment (mostly Black neighborhoods, schools, and college) most of their lifetimes.

This study demonstrates that psychosocial factors such as anger and hostility predict resting blood pressure in healthy normotensive African Americans. Thus, psychosocial factors should be evaluated in addition to the more traditional risk factors (insulin resistance, cholesterol, waist circumference) when assessing cardiovascular risk in African Americans. Future research will increase the sample size and include a longitudinal study to evaluate if psychosocial factors continue to affect blood pressure and if these factors facilitate or mitigate the progression towards cardiovascular disease.

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Baseline characteristics of 176 self-reported normotensive African Americans recruited from the North Carolina Triangle region

Table 1

Characteristic	Total n	Overall Mean (SD)	Women, n	Women, Mean (SD)	Men, n	Men, Mean (SD)
Age, years	176	32 (12)	113	33 (13)	63	32 (12)
SBP, mm Hg	175	121 (14)	112	118 (15)*	63	126 (12)*
DBP, mm Hg	175	74 (11)	112	74 (10)	63	74 (11)
MAP, mm Hg	175	91 (10)	112	90 (10)	63	93 (10)
Heart rate, bpm	175	69 (11)	112	71 (9)*	63	66 (13)*
Insulin resistance (HOMA)	101	1.6 (1.6)	63	2 (1.9)*	39	.9 (.9)*
Glucose, mg/dL	118	72 (29)	76	75 (30)	42	65.7 (26)
Insulin, μ U/mL	105	8.4 (7.5)	66	9.9 (7.9)*	39	5.9 (6)*
Waist, cm	148	87 (16)	95	86 (15)	53	90 (16)
BMI, kg/m ²	165	28.9 (6.6)	107	29.3 (6.8)	58	28.0 (6)
Triglycerides, mg/dL	116	88 (41)	74	87 (41)	42	89 (43)
Total cholesterol, mg/dL	116	182 (43)	74	185 (46)	42	178 (37)
HDL cholesterol, mg/dL	116	57 (16)	74	58 (16)	42	54 (15)
LDL cholesterol, mg/dL	116	107 (39)	74	109 (41)	42	104 (36)

SD = standard deviation, SBP = systolic blood pressure, DBP, diastolic blood pressure, MAP = mean arterial pressure, HOMA = homeostasis model assessment, BMI = body mass index, HDL = high-density lipoprotein, LDL = low-density lipoprotein.

* Significant ($P < .05$) difference between men and women at baseline according to the Wilcoxon Mann-Whitney nonparametric test.

Correlation of metabolic syndrome indices to resting cardiovascular parameters among 176 self-reported normotensive African Americans recruited from the North Carolina Triangle region

Table 2

	Age n=175	Glucose n=118	Insulin n=105	HOMA n=101	TG n=116	TC n=116	HDL n=116	LDL n=116	BMI n=164	Waist n=149
Mean resting	.41	-.03	-.07	-.15	.03	.11	.13	.04	.18	.34
SBP	<.0001*	.73	.49	.13	.73	.26	.16	.66	.023*	<.0001*
Mean resting	.44	-.01	-.10	-.19	.024	.06	.14	.01	-.005	.12
DBP	<.0001*	.91	.33	.055	.80	.52	.13	.93	.95	.14
Mean resting	.45	-.02	-.08	-.17	.06	.08	.16	.01	.08	.23
MAP	<.0001*	.81	.47	.082	.71	.40	.10	.87	.29	.0041*
Mean Resting	.18	.24	.33	.37	-.08	.05	.12	.02	.06	.12
HR	.015*	.0098*	.0005*	.0001*	.41	.56	.20	.85	.45	.14

* Significant at $P=.025$ by two-tailed test; in each cell the top number represents Pearson Correlation Coefficient and bottom number Prob > |r| under $H_0: \text{Rho}=0$.

Table 3

Correlation of psychosocial factors to resting cardiovascular parameters

	Perceived Racism N=173	Anger Expression (SAE) N=50	Anger-control (SAE) N=50	Aggressive Responding (CMH) N=50	ISEL N=169	John Henryism (JHAC) N=174	BDI N=172
Mean resting	-.07	.23	.29	.31	.05	.05	.08
SBP	.34	.094	.045 [†]	.031 [†]	.49	.52	.29
Mean resting	-.07	.25	.28	.32	.12	.07	.07
DBP	.38	.079	.048 [†]	.023*	.12	.36	.36
Mean resting	-.08	.28	.32	.33	.10	.07	.09
MAP	.28	.048 [†]	.023*	.020*	.21	.36	.25
Mean resting	-.11	.21	.19	.06	.04	-.07	.09
HR	.14	.15	.18	.65	.61	.33	.26

* = significant at p=.025 by two-tail test.

[†] = significant at .05 using one-tail test; in each cell the top number represents Pearson Correlation Coefficient and bottom number Prob > |r| under H0: Rho=0.

Table 4
Multivariate regression model for resting systolic blood pressure with 156 observations and r^2 of .32

Variable	Coefficient (β)	Standard Error	95% Confidence Interval	t value	P value
Intercept	101.11*	5.87	89.51 to 112.71	17.22	<.0001
Age	.50	.08	.34 to .67	6.10	<.0001
Female sex	-1.69*	2.12	-14.87 to -6.51	-5.05	<.0001
Male sex	.00*
Body mass index	.42	.15	.12 to .72	2.77	.0063
Lifetime perceived racism	-.10	.03	-.17 to -.03	-2.91	.0042
Hostility subscale, aggressive responding	3.83	4.57	-5.20 to 12.87	.84	.4025
Anger subscale, anger control	.27	.45	-.62 to 1.16	.59	.5538

* Parameters with values that are not uniquely estimable.