SOCIAL DETERMINANTS OF CARDIOVASCULAR HEALTH AMONG BLACK AND WHITE WOMEN RESIDING IN STROKE BELT AND BUCKLE REGIONS OF THE SOUTH

Sharon K. Davis, MEd, MPA, PhD; Samson Gebreab, PhD; Rakale Quarells, PhD; Gary H. Gibbons, MD

Objective: To assess the associations of social determinants on cardiovascular health among White and Black residing in Stroke Belt (urban) and Stroke Buckle (rural) regions of the South.

Design: A cross-sectional observational analysis based on a random digit-dial telephone survey of a representative sample of White and Black adults residing in urban and rural Georgia conducted from 2004–2005. Separate logistic regression analyses examined the effects of social determinants on cardiovascular health within and between White and Black women and within and between urban and rural residential location. The main outcome measure was poor cardiovascular health defined as ≥2 self-reported clinical cardiovascular disease risk factors (hypertension, diabetes, elevated cholesterol, overweight or obese). Social determinants were defined as socioeconomic status (SES), general daily stress, racial discrimination, and stress due to exposure to racial discrimination. Significance was established as a two-tailed $P<.05$.

Results: A total of 674 White and Black women aged 18–90 years were included in the sample. Results showed Black women with lower SES had worse cardiovascular health than White women in both rural and urban areas (rural odds ratio [OR] 2.68; confidence interval [CI] 1.44, 4.90; $P=.001$; urban OR=2.92; CI=1.62, 5.23; $P=.0003$). White women reporting high or very high exposure to general daily stress where more likely to have worse cardiovascular health than White women reporting very little to no daily stress (OR =2.85; CI=1.49, 5.44; $P=.001$).

Conclusion: Our findings demonstrate the importance of social determinants associated with cardiovascular health. Tailored cardiovascular risk reduction intervention is needed among lower SES Black women in Stroke Belt and Buckle regions of the South, as well as stress-reduction intervention among White women in the South. (*Ethn Dis*. 2014;24[2]: 133–143)

Key Words: Black, White, Women, Cardiovascular Risk Factor, Social Determinants, Stroke, South

INTRODUCTION

Social determinants of health are increasingly being recognized as a major source of health disparities – including racial and geographic disparities.[1–2] Social determinants of health refer to social conditions in which people are born, grow, work, and live. These social conditions include, but are not limited to, race and ethnicity, geographic location, socioeconomic status (SES) and psychosocial factors.[3–4]

Social determinants have been proven to be an important factor in the development of cardiovascular disease (CVD) and related risk factors.[5–7] Numerous studies have established inverse association of SES with various CVD risk factors, including hypertension, diabetes and obesity.[8–12] In addition, a growing body of research has shown strong association between psychosocial factors and CVD risk factors.[13–15] Furthermore, racial and geographic differences and the effects of social determinants on CVD have been documented.[12] For example, CVD risk factors are higher among Black women than White women.[8] Previous studies have also demonstrated that a higher prevalence of CVD-related risk factors, morbidity and mortality occur in the southern regions of the United States.[16–19] A certain area of the South is referred to as the "Stroke Belt" and the rural coastal region as the "Stroke Buckle" due to disproportionately higher rates of CVD-related conditions.[20–21] Evidence suggests that social determinants, including SES and psychosocial factors, may explain the observed racial and geographic disparities in these regions.[17,19–20]

Although numerous studies have examined the associations between social determinants and CVD risk factors, most used restricted sets of social determinants.[8] Relatively few studies have examined at a wider range of social determinants simultaneously, including psychosocial factors.[5–7,9–13] Furthermore, little empirical research has been reported on the differential associations between social determinants and cardiovascular health by race and location.[4,12] To our knowledge, this is one of the few studies to examine the associations between multiple social determinants and cardiovascular health among Black and White women in urban Stroke Belt and rural Stroke Buckle regions of the

From National Human Genome Research Institute, Inherited Disease Branch, Center for Research on Genomics and Global Health (GHG) and its Social Epidemiology Unit (SKD, SG); and Morehouse School of Medicine, Social Epidemiology Research Center, Cardiovascular Research Institute (RQ); and the National Heart, Lung, and Blood Institute (GHG).

Address correspondence to Sharon K. Davis, MEd, MPA, PhD; National Human Genome Research Institute; Inherited Disease Branch; Center for Research on Genomics and Global Health; Social Epidemiology Unit; 10 Center Drive, Room 7N320, MSC 1644; Bethesda, MD 20892; 301.594.2970; 301.480.0063 (fax); sharon.davis@nih.gov

The purpose of our study was to assess the association of multiple social determinants on poor cardiovascular health among Black and White women living in the stroke belt and buckle regions of the Southeast, specifically Georgia.

South. Understanding the underlying associations of social determinants may provide clues about the etiology of cardiovascular health and may help improve cardiovascular health among women in this region.

We examined the associations between four key social determinants (SES, daily stress, racial discrimination and stress due to discrimination) and cardiovascular health among Black and White women. We hypothesized differential associations of social determinants with cardiovascular health in Black and White women. We also hypothesized variations in the associations between urban areas and rural areas. Finally, we hypothesized that the associations would partially attenuate after adjustment for behavioral risk factors including smoking status, weekly physical activity, and daily consumption of fruits and vegetables. The purpose of our study was to assess the association of multiple social determinants on poor cardiovascular health among Black and White women living in the stroke belt and buckle regions of the Southeast, specifically Georgia.

METHODS

Data for this study were obtained from a cross-sectional survey of the Regional Assessment Health Surveillance Study (RAHSS). Data were collected from 2004–2005. The study population comprised self-identified Black and White men and women who were aged ≥18 years from five counties in Georgia. A random sample telephone survey using random digital dial was conducted to select participants from four rural counties (Bulloch, Candler, Evans, and Jenkins) representing the Stroke Buckle and one urban county (Fulton) representing the Stroke Belt. After excluding missing information on cardiovascular health, social determinants and covariates, a total sample of 674 women were included in the analyses. Men were excluded because of previous analyses.[4] Among the women, 397 were White and 277 were Black. Three hundred thirty three women were from rural areas and 341 women were from urban areas.

The telephone survey was conducted by the Southern Research Group (SRG), which has more than 15 years of experience conducting telephone interview for the Behavioral Risk Factor Surveillance System (BRFSS), developed by the Centers for Disease Control and Prevention (CDC). The instrument used in the RAHSS was based on a modified version of the validated Behavioral Risk Factor Surveillance Survey and well-validated measures of psychosocial factors (daily stress, discrimination, and stress due to discrimination).[22–24] The study was approved by the Institutional Review Board of Morehouse School of Medicine and all participants provided informed consent prior to the telephone survey.

Cardiovascular Health

The main outcome included poor cardiovascular health defined as ≥ 2 self-reported CVD clinical risk factors. Clinical risk factors were based on respondents who answered ''yes'' to separate questions of ever being told by a doctor, nurse or other health professional that they had diabetes, hypertension, and/or elevated cholesterol. Obesity status was also included as a clinical risk factor based on self-reported height and weight. Individuals with a BMI of ≥ 25 kg/m^2 were considered overweight or obese and at greater risk for CVD.

Social Determinants

Four measures of social determinants included: SES (education level, annual household income, and employment status); general daily stress; racial discrimination; and, stress due to exposure to racial discrimination. Respondents were asked their highest level of education; levels were collapsed into three categories: less than high school, high school diploma or Graduate Equivalency Diploma (GED), and some college or more. Annual household income was also collapsed into three categories: $<25,000, ≥$25,000-<$50,000 and ≥$50,000. Employment status was collapsed into two categories: employed (those employed full-time, self-employed, retired), and unemployed (those out of work, unable to work or students). Exposure to daily stress was assessed based on response to the question: ''How would you rank the level of day-to-day stress and worry in your life?'' Possible answers were: 1) very little to none; 2) some; 3) high or very high. Racial discrimination was assessed based on response to the question: ''In general, have you ever experienced racial discrimination in any aspect of your life such as work, school or shopping because of the color of your skin and race that was stressful?'' Possible answers included 1) yes or 2) no. Stress due to racial discrimination was measured based on response to the question: ''Please rank your level of stress when you experienced racial discrimination.'' Possible responses to this query were: 1) low to no stress; or 2) moderate or high stress.

Covariates

Covariates used in this study included self-reported age at the time of survey, race (Black or White), location (urban or rural) and behavioral risk factors including smoking status, weekly physical activity, and daily consumption of fruits and vegetables. Smoking status

was assessed based on two questions: ''Do you now smoke cigarettes every day, some days, or not at all?'' and ''Have you smoked at least 100 cigarettes in your entire life?'' Participants were classified as current smokers (1=yes, 0=no) if they smoked at least 100 cigarettes in their lifetime and were currently smoking either 'every day' or 'some days.' Participants who indicated they had smoked at least 100 cigarettes during their lifetime but did not currently smoke 'some days' or 'every day' were classified as former smokers (1=yes, 0 =no). Participants who indicated that they had never smoked were classified as never smokers (yes=1, 0=no). Weekly physical activity was based on questions regarding participation in moderate-intensity and vigorous-intensity physical activities. Participants were asked, ''When you are not working, in a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes some increase in breathing or heart rate?'' A similar question was asked for vigorous-intensity activities, ''When you are not working, in a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate?'' Participants who answered ''yes'' to each activity were then asked, ''How many days per week do you do these moderate or vigorous activities for at least 10 minutes at a time?'' Finally, they were asked, ''On days when you do moderate or vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?'' Using the 2008 Physical Activity Guidelines, participants were classified as physically active (1= yes) if they reported a combination of moderate-intensity and vigorous-intensity activity totaling at least 150 minutes per week; otherwise they were classified as not physically active (0=no).[25] Daily consumption of fruits and vegetables was assessed using six questions measuring the frequency of drinking fruit juice and eating fruit, green salad, nonfried potatoes, carrots, and other vegetables. The frequencies of these six food categories were then combined to form the total number of servings of fruits and vegetables per day. If the total number of servings was five or more, participants were classified as having recommended intake of fruits and vegetables (1=yes); otherwise, they were classified as not having adequate intake (0=no).

Statistical Analyses

Descriptive statistics were used to compare the distribution of demographic variables, CVD outcomes, social determinants and behavioral factors between Blacks and Whites in urban and rural areas. To examine Black-White differences in these variables χ^2 test was used for categorical variables and t test was used for continuous variables. We stratified all analyses by race and location.

Logistic regression analyses were conducted to examine the associations of social determinants with the presence of ≥2 CVD clinical risk factors. The analyses were stratified by race (Black and White) and residential location (rural and urban). Due to high correlation between SES indicators, separate models were fitted for each SES indicator (education, employment status and annual household income). In each of these models psychosocial factors (daily stress, racial discrimination, and stress due to racial discrimination) and other covariates were included. We first fitted age-adjusted models separately for education, employment and annual household income and all psychosocial variables (Model 1) and a second model was fitted adjusting for behavioral CVD risk factors (Model 2), which included variables in Model 1 to determine whether any social determinants effects observed in Model 1 could be mediated in part by behavioral factors. The behavioral CVD risk factors included in the model were current smoker, former smoker, never smoked, weekly physical activity and daily consumption of fruits and vegetables. We also examined the interactions between social determinants with race and location in predicting cardiovascular health. Because there were interactions between education and race and daily stress and location, stratified results by race and location are given. Odds ratios (OR) and 95% confidence intervals (CI) were reported as a two-tailed $P<.05$. All analyses were performed using Statistical Analyses Software version 9.3.[26]

RESULTS

Our study sample included 184 White and 157 Black women who resided in urban locations ($n=341$) and 213 White and 120 Black women who resided in rural locations ($n=333$). We compared White women versus Black women and those residing in rural versus urban locations. Table 1 shows mean age was similar for women in rural and urban locations – regardless of race ($P=.3254$ and .6458,'' respectively). Comparison of CVD risk factors shows there was a significant difference between Black and White Women. Black women were more likely to be overweight or obese (ie, BMI ≥25), (74% vs 56%, $P=.0012$ in rural and 68% vs 39%, $P<.0001$ in urban) and had a higher proportion of hypertension (51% vs 39%, $P=.0290$ in rural and 34% vs 47%, $P=.0212$ in urban). Compared to White women in both areas, Black women in urban areas had a higher proportion of diabetes (17% vs 4%, $P=.0002$), but no significant difference was observed in rural areas (15.83 vs 14.08%, $P=.6654$). Overall, Black women living in rural and urban areas had a significantly higher proportion of ≥2 CVD risk factors than White women residing in the same area

Table 1. Descriptive table for women's cardiovascular health: Regional Assessment of Health Surveillance Study, 2004–2005[a]

Characteristics	Rural (*n*=333)			Urban (*n*=341)		
	White	Black	*P*	White	Black	*P*
Age, Years, Mean (SD)	52.50 (17.60)	50.75 (16.30)	.3254	49.03 (17.02)	48.18 (17.18)	.6458
	%	%		%	%	
Cardiovascular clinical risk factors						
BMI category[b]			.0012			<.0001
BMI ≥25	56.34	74.17		37.50	68.15	
BMI <25	43.66	25.83		62.50	31.85	
Hypertension status			.0290			.0212
Yes	38.50	50.83		34.24	46.5	
No	61.50	49.17		65.76	53.5	
Diabetes status			.6654			.0002
Yes	14.08	15.83		4.35	16.56	
No	85.92	84.17		95.65	83.44	
Cholesterol status			.0851			.9343
Yes	39.44	30.00		32.07	67.52	
No	60.56	70.00		67.93	32.48	
Clinical risk factors[c]			.1858			.0005
≥2	44.13	51.67		35.33	54.14	
<2	55.87	48.33		64.67	45.86	
Social determinants						
Education			.0120			<.0001
<High school	16.43	22.50		2.72	10.19	
High school	29.11	40.00		9.78	33.12	
Some college or more	54.46	37.50		87.50	56.69	
Employment[d]			.1249			.0002
Unemployed	15.02	21.67		11.96	28.03	
Employed	84.98	78.33		88.04	71.97	
Annual household income			.0004			<.0001
<$25 K	44.13	61.67		11.41	52.23	
≥$25K and <$50K	27.23	27.50		27.17	32.48	
≥$50K	28.64	10.83		61.41	15.29	
General daily stress			.0023			.0007
Very little or none	24.88	43.33		26.63	46.5	
Moderate	41.31	31.67		39.13	28.03	
High or very high	33.8	25.00		34.24	25.48	
Exposure to racial discrimination			<.0001			<.0001
Yes	15.02	47.50		30.43	55.41	
No	84.98	52.50		69.57	44.59	
Stress related to racial discrimination			<.0001			<.0001
Low or no stress at all	88.73	62.50		75.00	54.14	
Moderate or higher	11.27	37.50		25.00	45.86	
Behavioral risk factors						
Smoking			.0503			.0035
Current	17.84	9.17		13.59	21.02	
Former	17.37	14.17		33.15	17.83	
Never	64.79	76.67		53.26	61.15	
Physical activity (PA)			.0248			.015
≥150 minutes of PA/week	49.51	36.52		59.32	44.67	
No or <150 minutes of PA/week	50.49	63.40		40.68	55.33	
Fruits and vegetables			.4990			.0668
No or consume <5 serving per day	74.18	77.50		69.57	78.34	
Consume 5 or more serving per day	25.82	22.50		30.43	21.66	

[a] Data were derived from a cross-sectional telephone survey conducted from 2004–2005 in one urban area (Fulton County) and four rural coastal areas (Bulloch, Candler, Evans and Jenkins Counties) in Georgia using random digit dial sampling.
[b] BMI, body mass index, which was calculated as weight in kilograms divided by the square of height in meters.
[c] Self-reported diabetes, hypertension, elevated cholesterol and BMI ≥25.
[d] Employed included respondents who were self-employed, employed full-time and retirees unemployed included respondents who were out of work, unable to work, or students.

(52% vs 44% and 54% vs 35%, respectively; $P=.1858$ and .0005, respectively).

Compared with White women, a significantly lower proportion of Black women in the urban area graduated from high school (10% vs 3%, $P<.0001$) and a higher proportion were unemployed (28% vs 12%, $P=.0002$). A higher proportion of Black women in rural and urban areas had an annual household income of <$25,000 when compared to White women in rural and urban areas (62% vs 44% $P=.0004$ and 52% vs 11%, $P=.0001$, respectively). A higher proportion of Black women when compared to White women in rural and urban areas reported exposure to racial discrimination (48% vs 15% in rural, $P<.0001$; 55% vs 30% in urban, $P<.0001$) and face higher stress due to racial discrimination (38% vs 11% in rural, $P<.0001$; 46% vs 25% in urban, $P<.0001$). In contrast, a lower proportion of Black women reported general daily stress when compared to White women (25% vs 34% in rural, $P=.0023$; 25% vs 35% in urban, $P=.0007$).

A higher proportion of rural White women were current smokers than rural Black women (18%, 9%, $P=.02$ respectively). However, a higher proportion of urban Black women were current smokers when compared to urban White women (21% vs 14%, $P=.0035$, respectively). No significant racial differences in rural or urban locations were observed with respect to weekly physical activity and daily consumption of fruits and vegetables.

Social Determinants and Cardiovascular Health by Location

The associations between social determinants and cardiovascular health stratified by location are presented in Table 2. The results show significant, inverse, graded associations between individual SES indicators and cardiovascular health among women in both rural and urban areas as shown by *P* for level of education, employment status and annual household income. Among rural women, having less than high school education (OR= 2.38, 95% CI: 1.15, 4.92; $P=.0159$), being unemployed (OR=3.47, 95% CI: 1.73, 6.96; $P=.0006$) and having lower annual household income (OR=2.14, 95% CI: 1.12, 4.09; $P=.0148$) was associated with worse cardiovascular health outcome. Similar patterns, but slightly weaker associations, were observed among urban women. Adjustments for behavioral risk factors (smoking status, weekly physical activity, daily consumption of fruits and vegetables) slightly attenuated the associations for employment and income in rural areas, but remained statistically significant in the urban area (Model 2).

Table 2 also shows that exposure to high or very high daily stress was inversely associated with cardiovascular health among rural women. In rural areas, women exposed to high or very high daily stress had 3.7 to 4.5 increased odds of having worse cardiovascular health than those reporting very little or no stress in separate models for each SES indicator. This pattern still persisted even after adjustment for behavioral risk factors. However, this association was not observed in urban women. Furthermore, our results show that racial discrimination and stress due to racial discrimination were not significantly associated with cardiovascular health in rural and urban women. Results, however, show lower SES Black women had worse cardiovascular health than White women in both rural and urban areas.

Social Determinants and Cardiovascular Health by Race

The associations between social determinants and cardiovascular health stratified by race are presented in Table 3. Socioeconomic status indicators were generally inversely associated with cardiovascular health in both Black and White Women. Among Black women cardiovascular health was inversely associated with having less than high school education (OR= 3.56, 95% CI: 1.56, 8.36; $P<.0001$), being unemployed (OR= 2.41, 95% CI: 1.28, 4.52; $P<.0062$), and having lower household income (OR= 3.00, 95% CI: 1.31, 6.86; $P<.0053$). Among White women an inverse association was only significant for unemployment (OR= 2.54, 95% CI: 1.26, 5.12; $P<.0082$). Tests for trend show stronger patterns with all SES indicators among Black women compared with White women. This trend persisted after adjustments were made for behavioral CVD risk factors (Model 2).

Table 3 also shows that general daily stress was a significant predictor of cardiovascular health among White women in all separate models for education, employment status, and income. Compared with those reporting very little to no daily stress, White women reporting high or very high daily stress had 2.60 to 2.85 increased odds of having worse cardiovascular health, even after adjustments for CVD risk factor behavior (Model 1). Black women exposed to high or very high general daily stress were significantly more likely to have worse cardiovascular health than Black women reporting very little to no daily stress only in the employment status and annual household income age adjusted models. This association was lessened after adjusting for the behavioral CVD risk factors (Model 3). Exposure to racial discrimination and stress related to racial discrimination were not significantly associated with cardiovascular health in White or Black women. Residential location was not significantly associated with cardiovascular health in either White or Black Women.

DISCUSSION

We investigated the associations of four key social determinants with cardiovascular

Table 2. Adjusted logistic regression models of the associations between social determinants on cardiovascular health among women living in rural versus urban areas

	Rural (*n*=333)						Urban (*n*=341)					
	Model 1[a]			Model 2[a]			Model 1[a]			Model 2[a]		
Primary Predictors	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Education[b]												
<high school	2.38	(1.15, 4.92)		1.86	(.86, 4.04)		2.986	(.94, 9.54)		3.74	(1.11, 3.94)	
High school	1.46	(.85, 2.52)		1.408	(.79, 2.51)		2.165	(1.11, 4.22)		2.00	(1.02, 4.22)	
Some college or more		Referent			Referent			Referent			Referent	
			.0159			.0985			.0089			.0069
Employment[c]												
Unemployed	3.47	(1.73, 6.96)		2.60	(1.24, 5.45)		2.105	(1.10, 4.01)		1.90	(.98, 3.68)	
Employed		Referent			Referent			Referent			Referent	
			.0006			.0068			.0184			.0376
Annual household income[d]												
< $25 K	2.14	(1.123, 4.09)		2.01	(1.03, 3.94)		2.10	(1.04, 4.26)		2.10	(1.02, 4.34)	
≥ $25K and < $50k	1.26	(.63, 2.539)		1.42	(.69, 2.93)		1.43	(.77, 2.66)		1.46	(.76 ,2.80)	
≥ $50K		Referent			Referent			Referent			Referent	
			.0148			.0447			.0274			.0398
General Daily Stress												
High to Very high	3.65[b]	(1.86, 7.16)		3.91[b]	(1.93, 7.94)		1.53[b]	(.80, 2.91)		1.54[b]	(.79, 3.00)	
	4.46[c]	(2.24, 8.90)		4.46[c]	(2.18, 9.15)		1.46[c]	(.76, 2.79)		1.49[c]	(.76, 2.89)	
	3.86[d]	(1.97, 7.55)		4.05[d]	(2.00, 8.22)		1.50[d]	(.79, 2.85)		1.53[d]	(.79, 2.96)	
Some	2.38[b]	(1.29, 4.48)		2.64[b]	(1.35, 5.15)		.83[b]	(.45, 1.54)		.77[b]	(.40,1.47)	
	2.80[c]	(1.47, 1.47)		2.92[c]	(1.48, 5.77)		.85[c]	(.46, 1.56)		.79[c]	(.42, 1.48)	
	2.50[d]	(1.33, 4.72)		2.78[d]	(1.41, 5.46)		.87[d]	(.47, 1.61)		.81[d]	(.43, 1.54)	
Very little or none		Referent			Referent			Referent			Referent	
			.0002[b]			.0004[b]	.0.829[b]	(0.447, 1.536)	.02035	0.770[b]	(0.404, 1.466)	.0.2371[b]
			<.0001[c]			<.0001[c]	0.845[c]	(0.458, 1.558)	.0.2673[c]	0.785[c]	(0.416, 1482)	.0.2847[c]
			<.0001[d]			.0002[d]	.0.870[d]	(0.471, 1.607)	.0.2275[d]	0.811	(0.428, 1.537)	.0.2434[d]
Racial discrimination												
Yes	.843[b]	(.284, 2.505)		.866[b]	(.277, 2.708)		.74[b]	(.27, 2.02)		.70[b]	(.21, 1.97)	
	.73[c]	(.25, 2.14)		.79[c]	(.26, 2.43)		.63[c]	(.23, 1.72)		.59[c]	(.21, 1.67)	
	.79[d]	(.27, 2.33)		.83[d]	(.27, 2.58)		.61[d]	(.22, 1.67)		.57[d]	(.20, 1.62)	
No		Referent			Referent			Referent			Referent	
			.7422[b]			.6794[b]			.5663[b]			.6104[b]
			.5510[c]			.5686[c]			.3698[c]			.3900[c]
			.6445[d]			.6387[d]			.3428[d]			.3738[d]
Stress related to racial discrimination												
Moderate or higher	.94[b]	(.30, 2.969)		.78[b]	(.23, 2.59)		1.80[b]	(.65, 5.01)		1.77[b]	(.62, 5.10)	
	1.04[c]	(.33, 3.25)		.83[c]	(.25, 2.74)		1.77[c]	(.63, 4.95)		1.76[c]	(.61, 5.13)	
	1.00[d]	(.32, 3.17)		.81[d]	(.24, 2.72)		1.90[d]	(.68, 5.35)		1.89[d]	(.65, 5.53)	
Low or no stress at all		Referent			Referent			Referent			Referent	
			.9595[b]			.8599[b]				.2873[b]		.3633[b]

Table 2. Continued

Primary Predictors	Rural (*n*=333)						Urban (*n*=341)					
	Model 1[a]			Model 2[a]			Model 1[a]			Model 2[a]		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
			.8798[c]			.9552[c]				.2908[c]		.3644[c]
			.9452[d]			.9170[d]				.2315[d]		.3068[d]
Covariates												
Race (Black vs White/referent)	1.92[b]	(1.08, 3.42)	.0261	2.52[b]	(1.34, 4.74)	.0042	2.09[b]	(1.17, 3.75)	.0134	2.41[b]	(1.30, 4.48)	.0055
	2.16[c]	(1.22, 3.82)	.0085	2.68[c]	(1.44, 4.98)	.0019	2.54[c]	(1.47, 4.39)	.0008	2.92[c]	(1.62, 5.23)	.0003
	1.89[d]	(1.06, 3.36)	.0305	2.44[d]	(1.30, 4.58)	.0056	2.03[d]	(1.09, 3.80)	.0257	2.32[d]	(1.21, 4.47)	.0118

[a] Model 1 includes separate age adjusted models with location for education, employment, and annual household income along with exposure to general daily stress, exposure to racial discrimination, and level of stress due to exposure to racial discrimination. Model 2 includes separate age adjusted models with location for education, employment, and annual household income along with level of general daily stress, exposure to racial discrimination, level of stress due to exposure to racial discrimination and behavioral cardiovascular risk factors including smoking status (current, former, and never smoker), weekly physical activity, and daily consumption of fruits and vegetables).
[b] Model with education; all three models included age, location, exposure to general daily stress, exposure to racial discrimination, and level of stress due to exposure to racial discrimination.
[c] Model with employment.
[d] Model with annual household income.

health among Black and White women residing in rural and urban regions of Georgia. To our knowledge, there are only a few studies that simultaneously examined the various dimensions of social determinants of cardiovascular health and none were conducted among White and Black women residing in Stroke Belt and Buckle regions of the South. Our findings add to the body of knowledge by providing information on the association of multiple social determinants on poor cardiovascular health among women in a region of the country at higher risk for cardiovascular disease. Overall, we found Black women were more likely to have worse cardiovascular health compared with White women in both locations. Our results generally showed all SES indicators (education, unemployment and income) were inversely associated with cardiovascular health in both Black and White women. We found daily stress was inversely associated with cardiovascular health, but only among rural women and White women. However, we found no evidence of associations of discrimination and stress due to discrimination in both Black and White women.

Consistent with previous findings, our results demonstrated a graded inverse association between SES and cardiovascular health in both Black and White women residing in rural and urban areas.[8,12,27,28] Our results indicate that women with lower SES had worse cardiovascular health, regardless

Overall, we found Black women were more likely to have worse cardiovascular health compared with White women in both locations [rural, urban].

Table 3. Adjusted logistic regression of the associations between social determinants on cardiovascular health among White and Black women

	White (*n*=397)						Black (*n*=277)					
	Model 1[a]			Model 2[a]			Model 1[a]			Model 2[a]		
Primary Predictors	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Education												
<High school	2.19	(.90, 5.33)		1.77	(.71, 4.38)		3.56	(1.515 ,8.364)		3.75	(1.522 ,9.246)	
High school	.52	(.28, .98)		.56	(.29, 1.07)		5.14	(2.734, 9.676)		4.51	(2.341, 8.677)	
Some college or more		Referent			Referent			Referent			Referent	
			.5503			.8689			<.0001			<.0001
Employment												
Unemployed	2.54	(1.26, 5.12)		2.07	(.98, 4.35)		2.41	(1.284, 4.522)		2.07	(1.087,3.956)	
Employed		Referent			Referent			Referent			Referent	
			.0082			.0441			.0062			.0169
Annual household income												
<$25 K	1.67	(.90, 3.11)		1.64	(.85, 3.16)		3.00	(1.314, 6.861)		2.79	(1.200, 6.489)	
≥$25K and <$ 50k	1.24	(.71, 2.19)		1.43	(.79, 2.58)		1.75	(.74, 4.115)		1.68	(.693, 4.067)	
≥$50K		Referent			Referent			Referent			Referent	
			.0998			.1797			.0053			.0083
General Daily Stress												
High or very high	2.60[b]	(1.53, 5.71)		3.54[b]	(1.78, 7.06)		1.76[b]	(.88, 3.17)		1.67[b]	(.81, 3.40)	
	2.83[c]	(1.46, 5.42)		3.33[c]	(1.69, 6.56)		1.96[c]	(1.00, 3.82)		1.80[c]	(.90, 3.57)	
	2.85[d]	(1.49, 5.44)		3.40[d]	(1.72, 6.71)		1.88[d]	(.97, 3.64)		1.76[d]	(.89, 3.48)	
Some	1.51[b]	(.82, 2.79)		1.79[b]	(.94, 3.41)		1.41[b]	(.73, 2.71)		1.28[b]	(.65, 2.53)	
	1.55[c]	(.84 , 2.86)		1.80[c]	(.95 , 3.42)		1.51[c]	(.80, 2.83)		1.33[c]	(.69, 2.56)	
	1.52[d]	(.82, 2.81)		1.83[d]	(1.83, 3.486)		1.53[d]	(.81, 2.89)		1.36[d]	(.70, 2.65)	
Very little or none		Referent			Referent			Referent			Referent	
			.0010[b]			.0005[b]			.0949[b]			.1924[b]
	.0014[c]		.0014[c]		.0006[c]				.0451[c]			.1146[c]
	.0012[d]		.0012[d]		.0005[d]				.0549[d]			.1277[d]
Racial discrimination												
Yes	.59[b]	(.16, 2.24)		.68[b]	(.18, 2.61)		1.20[b]	(.457, 3.17)		1.06[b]	(.39, 2.87)	
	.58[c]	(.16, 2.20)		.67[c]	(.18, 2.59)		1.25[c]	(.496, 3.12)		.73[c]	(.28, 1.88)	
	1.79[d]	(.44, 7.32)		.64[d]	(.16, 2.47)		.86[d]	(.34, 2.12)		.78[d]	(.30, 2.06)	
No		Referent			Referent			Referent			Referent	
			.3727[b]			.4249[b]			.8229[b]			.8505[b]
			.4110[c]			.4669[c]			.5890[c]			.5931[c]
			.3489[d]			.4167[d]			.7234[d]			.7305[d]
Stress related to racial discrimination												
Moderate or higher	1.68[b]	(.409, 6.904)		1.31[b]	(.311, 5.513)		1.12[b]	(.42, 2.95)		1.12[b]	(.41, 3.03)	
	1.62[c]	(.396, 6.581)		1.26[c]	(.300,5.304)		1.25[c]	(.50, 3.12)		1.18[c]	(.50, 3.11)	
	1.79[d]	(.438, 7.322)		1.37[d]	(.324, 5.806)		1.28[d]	(.50, 3.30)		1.23[d]	(.46, 3.33)	
Low or no stress at all		Referent			Referent			Referent			Referent	
			.3940[b]			.5265[b]			.8178[b]			.9998[b]
			.4917[c]			.6243[c]			.6141[c]			.8047[c]

Table 3. Continued

Primary Predictors	White (*n*=397)						Black (*n*=277)					
	Model 1[a]			Model 2[a]			Model 1[a]			Model 2[a]		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
			.3974[d]			.5358[d]			.5682[d]			.7643[d]
Covariates												
Location (rural vs urban/referent)	1.24[b]	(.76, 2.04)	.4984	1.37[b]	(.82, 2.31)	.2291	.59[b]	(.336, 1.042)	.069	.67[b]	(.37, 1.21)	.1834
	1.18[c]	(.73, 1.89)	.3872	1.30[c]	(.79, 2.14)	.3042	.82[c]	(.485, 1.385)	.458	.94[c]	(.54, 1.63)	.8269
	1.04[d]	(.63, 1.73)	.8832	1.149[d]	(.68, 1.95)	.6080	.73[d]	(.434, 1.241)	.248	.86[d]	(.50, 1.49)	.5921

[a] Model 1 includes separate age adjusted models with location for education, employment, and annual household income along with exposure to general daily stress, exposure to racial discrimination, and level of stress due to exposure to racial discrimination. Model 2 includes separate age adjusted models with location for education, employment, and annual household income along with level of general daily stress, exposure to racial discrimination, level of stress due to exposure to racial discrimination and behavioral cardiovascular risk factors including smoking status (current, former, and never smoker), weekly physical activity, and daily consumption of fruits and vegetables).
[b] Model with education; all three models included age, location, exposure to general daily stress, exposure to racial discrimination, and level of stress due to exposure to racial discrimination.
[c] Model with employment.
[d] Model with annual household income.

of race and location. For White women, stronger gradients were observed with unemployment and income, but not with education. The lack of education gradient in White women could be due to the small number of White women not completing high school in our study. For Black women, we observed stronger patterns of poor cardiovascular health across all SES measures. This is in contrast to prior studies that found weaker associations with education and income in Black women and also contrary to the findings by Winkleby et al[30] and others who reported education to be stronger predictor of CVD risk factors than income and occupation among Whites.[12] However, our results are similar with Boykin et al who observed inverse socioeconomic gradients in hypertension, diabetes, and overweight in both White and Black women compared to Hispanic or Chinese women using the Multi-Ethnic Study of Atherosclerosis.[27] For Black women, however, higher education, higher income and employment may translate into better living conditions, less stressful environments and higher social standing compared to less educated Black women.

Our study uniquely contributes to the previous studies by expanding social determinants to include key variables of psychosocial factors including daily stress, racial discrimination, and stress due to discrimination. Other studies have analyzed such variables as psychosocial variables and not social determinants.[13–15] In our study, the relationship between daily stress and cardiovascular health were only significant among White women and women residing in rural areas. This association persisted even after adjusting for behavioral CVD risk factors. Our findings are consistent with prior findings that found exposure to daily stress was associated with poor health status.[13,27–29,31] A possible explanation for this finding may be that residing in a rural environment may present more obstacles to navigate on a daily basis, such as distance to travel to health care facilities, food markets, retail

outlets, inferior educational systems and low-paying jobs when compared to individuals residing in urban areas.

Racial discrimination and stress due to racial discrimination were not associated with cardiovascular health in either Black or White women in our study. Researchers have found inconsistent results on the associations of racial discrimination and stress due to discrimination.[15,23] Our results are in agreement with the findings from Roberts et al who found no association between everyday discrimination and hypertension in women in the Pitt County Study, NC.[32] On the other hand, Sims et al found lifetime discrimination and burden of discrimination were associated with greater hypertension prevalence in African Americans in the Jackson Heart Study.[15] However, the authors found no associations with everyday discrimination and also did not examine by sex. The reasons for these conflicting results are not clear; they may be due to differences in the instruments used to measure discrimination variables, sample size and effects of self-reported discrimination and geographic variation in the experience of discrimination.[33,34] Possible explanation for the lack of associations between racial discrimination and cardiovascular health in our study may be due, in part, to our sample being drawn from Georgia – particularly Atlanta - which is a predominantly African American population. This may mitigate some of the effects of racial discrimination by promoting a strong sense of community and social support, which in turn, reduces or even provides protective effects of racial discrimination.[35]

There are limitations that could affect the findings in our study. First, the study sample was drawn from one state in the southern region of the United States; therefore, the findings cannot be generalized to all women across the country. However, similar findings may be observed in other southern regions of the country. Second, we used self-report measures of SES, psychosocial factors and cardiovascular health; thus, they are prone to recall and self-report bias. It is difficult to know the degree to which recall and self-report bias affected the associations of social determinants with cardiovascular health in our study. Nevertheless, prior studies have demonstrated the accuracy of recall and self-report of cardiovascular disease history.[34] Third, although our study sample size was powered to detect the associations between measures of social determinants and cardiovascular health, the relatively small sample size especially when stratified by race and location resulted in fairly wide confidence interval for the odds ratio. Fourth, the cross-sectional nature of our data precludes establishing causal associations between social determinants and cardiovascular health.

Despite these limitations, our findings are consistent with the extensive body of work that demonstrates social determinants are associated with CVD risk factors. Unlike many prior studies, the strength of our study lies in its ability to simultaneously investigate a wide array of social determinants including psychosocial factors. An additional strength is that we have examined the differential associations of social determinants by race in a region of the country with a disproportionate burden of CVD. Our results partially support the hypothesis that there are differential associations of social determinants on cardiovascular health by race between Stroke Belt and Buckle regions of the South. We found rural and urban Black women had worse cardiovascular health when compared to rural and urban White women. We also found that various measures of SES were inversely associated with cardiovascular health, with similar gradients in both Black and White women. However, daily stress was inversely associated with worse cardiovascular health in rural women overall and in White and Black women in general. These findings suggest that targeted CVD risk reduction interventions should be implemented among southern Black women, lower SES Black and White women in the South, as well as stress-reduction interventions among White women and women in rural regions of the South. Additional longitudinal studies are needed to investigate the mechanisms by which different components of social determinants singularly or in combination affect cardiovascular health among women by race and in Stroke Belt and Buckle regions of the country.

ACKNOWLEDGMENTS

We would like to thank the respondents who participated in this study. Research was supported by a grant (5P20MD00272) from the National Institute on Minority Health and Health Disparities.

REFERENCES

1. Bambra C, Gibson M, Sowden A, Wright K, Whitehead M, Petticrew M. Tackling the wider social determinants of health and health inequalities: evidence from systemic reviews. *J Epidemiol Community Health*. 2010;64(4):284–291.
2. Kawachi I. Income inequality and economic residential segregation. *J Epidemiol Community Health*. 2002;56(3):165–166.
3. Wilkinson R, Marmot M. *Social Determinants of Health: The Solid Facts.* 2nd edition. Denmark: World Health Organization; 2003.
4. Quarells Collins R, Liu J, Davis SK. Social determinants of cardiovascular disease risk factor presence among rural and urban Black and White men. *J Mens Health*. 2012;9(2):120–126.
5. Ansari Z, Carson NJ, Ackland MJ, Vaughan L, Serraglio A. A public health model of the social determinants of health. *Soz Praventivmed*. 2003;48(4):242–251.
6. Kreatsoulas L, Anand SS. The impact of social determinants on cardiovascular disease. *Can J Cardiol*. 2010;26:8C–13C.
7. Lang T, Lepage B, Schieber SC, Lamy S. Social determinants of cardiovascular disease. *Public Health Rev*. 2011;33(2):601–622.
8. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation*. 1993;88(4pt1):1973–1998.
9. Diez-Roux AV, Nieto FJ, Tyroler HA, Crum LD, Szklo M. Social inequalities and atherosclerosis: The Atherosclerosis in Communities Study. *Am J Epidemiol*. 1995;141(10):960–972.

10. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). *J Epidemiol Community Health*. 2006;60(1):7–12.
11. Ranjit N, Diez-Roux AV, Chambless L, Jacobs DR Jr, Nieto FT, Szklo M. Socioeconomic differences in progression of carotid intima-media thickness in the Atherosclerosis Risk in Communities Study. *Arterioscler Thromb Vasc Biol*. 2006;26(2):411–416.
12. Karlamangla As, Merkin SS, Crimmins EM, Seeman TE. Socio-economic and ethnic disparities in cardiovascular risk in the United States, 2001–2006. *Ann Epidemiol*. 2010;20(8): 617–628.
13. Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation*. 1999;99:2192–2217.
14. Williams DR, Neighbors HW, Jackson JJ. Racial/ethnic discrimination and health: findings from community studies. *Am J Public Health*. 2003;93:200–208.
15. Sims M, Diez-Roux AV, Dudley A, et al. Perceived discrimination and hypertension among African Americans in the Jackson Heart Study. *Am J Public Health*. 2012;102:S258–S265.
16. Obisesan To, Vargas CM, Gillum RF. Geographic variation in stroke risk in the United States: region, urbanization, and hypertension in the Third National Health and Nutrition Examination Survey. *Stroke*. 2000;31:19–25.
17. Voeks JH, McClure LA, Go RC, et al. Regional differences in diabetes as a possible contributor to geographic disparity in stroke mortality: the Reasons for Geographic and Racial Differences in Stroke. *Stroke*. 2008; 39:1675–1680.
18. Murray JL, Kulkarni SC, Michaud C, et al. Eight americans: Investigating mortality, disparities across race, counties, and race-counties in the United States. *PLoS Med*. 2006;3(9):e260.
19. Mensah GA, Mokdad AH, Ford ES, Greenland KJ, Croft JB. State of disparities in cardiovascular health in the United States. *Circulation*. 2005;111:1233–1241.
20. Howard VJ, Kleindorfer DO, Judd SE, et al. Disparities in stroke incidence contributing to disparities in stroke mortality. *Ann Neurol*. 2011;69(4):619–627.
21. Bathala L. A visit to the stroke belt of the United States. *J Neurosci Rural Pract*. 2012; 3(3):426–428.
22. Nelson DE, Holtzman D, Bolen J, Stanwyck CA, Mack KA. Reliability and validity of measures from the Behavioral Risk Factor Surveillance System (BRFSS). *Soz Praventivmed*. 2001;46:suppl:S3–42.
23. Davis SK, Liu Y, Quarells Collins R, Din-Dzietham R. Stress-related racial discrimination and hypertension likelihood in a population-based sample of African Americans: The Metro Atlanta Heart Disease Study. *Ethn Dis*. 2005;15:585–593.
24. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24:385–396.
25. U.S. Department of Health and Human Services. 2008. *Physical Activity Guidelines for Americans*. 2008.
26. SAS Institute Inc. 2011. Base SAS 9.3 Procedures Guide. Carry, NC: SAS Institute Inc.
27. Boykin S, Diez-Roux AV, Carnethon M, Shrager S, Ni H, Glover-Whitt M. Racial/ethnic heterogeneity in the socioeconomic patterning of CVD risk factors in the United States. The Multi-Ethnic Study of Atherosclerosis. *J Health Care Poor Underserved*. 2011;22(1):111–127.
28. Winkleby MA, Ragland DR, Syme SL. Self-reported stressors and hypertension: evidence of an inverse association. *Am J Epidemiol*. 1988;127(1):124–134.
29. Schulz A, Israel B, Williams D, Parker E, Becker A, James S. Social inequalities, stressors and self-reported health status among African Americans and White women in Detroit metropolitan area. *Soc Sci Med*. 2000;51:1639–1653.
30. Winkleby MA, Cubbin C, Ahn DK, Kraemer HC. Pathways by which SES and ethnicity influence cardiovascular risk factors. *Annals NY Acad Sci*. 1999;896:191–209.
31. Chikani V, Reding D, Gunderson P, McCarty CA. Psychosocial work characteristics predict cardiovascular disease risk factors and health functioning in rural women: the Wisconsin Rural Women's Health Study. *J Rural Health*. 2005;21(4):295–302.
32. Roberts CB, Vines AI, Kaufman JS, James SA. Cross-sectional association between perceived discrimination and hypertension in African American men and women: The Pitt County Study. *J Epidemiol*. 2008;167(5):623–632.
33. Cuffee YL, Hargraves JL, Allison J. Exploring the association between reported discrimination and hypertension among African Americans: a systematic review. *Ethn Dis*. 2012;22(4):422–431.
34. Bowlin SJ, Morrill BD, Nafziger AV, Lewis C, Pearson TA. Reliability and changes in validity of self-reported cardiovascular disease risk factors using dual response: the Behavioral Risk Factor Survey. *J Clin Epidemiol*. 1996;49:511–517.
35. Halpern D, Nazroo JY. The ethnic density effect: results from a national community survey of England and Wales. *Int J Soc Psychiatry*. 1999;46:34–46.

AUTHOR CONTRIBUTIONS

Design and concept of study: Davis, Quarells, Gibbons
Acquisition of data: Davis
Data analysis and interpretation: Davis, Gebreab, Quarells, Gibbons
Manuscript draft: Davis, Gebreab, Quarells, Gibbons
Statistical expertise: Davis, Gebreab, Quarells, Gibbons
Acquisition of funding: Davis
Administrative: Davis
Supervision: Davis