Self-Reported Racism and Social Support Predict Blood Pressure Reactivity in Blacks

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ABSTRACT

This study explored the effects of perceived racism and social support (quantity and quality) on blood pressure reactivity. In a college sample of 64 Blacks (M age = 22.69 years, SD = 6.60), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were assessed before and during a standardized serial subtraction task. Perceptions of racism and the quantity and quality of social support were measured by self-report. Separate multiple regression analyses revealed that perceived racism and social support (neither quantity nor quality) were not independent predictors of SBP or DBP changes (ps > .05). These analyses did indicate that perceived racism interacted with the quantity of social support ($p < .002$, partial $R^2 = .175$) and with the quality of social support ($p < .0007$, partial $R^2 = .195$) to predict DBP changes. Perceived racism also interacted with the quantity of social support to predict changes in SBP ($p < .02$, partial $R^2 = .11$). In general, whereas high social support was related to less marked blood pressure changes under conditions of low perceived racism, high social support was associated with exaggerated blood pressure changes under conditions of high perceived racism. These significant interaction effects persisted after statistically controlling for potential confounders. The findings highlight the importance of examining the joint contribution of real-world experiences and coping resources to blood pressure reactivity in Blacks.

(**Ann Behav Med** 2003, *25*(2):127–136)

INTRODUCTION

Relative to other ethnic groups in the United States, the prevalence of primary hypertension (hypertension) is disproportionately higher among Blacks (1). The hypothesized psychosocial stress association with environmental events such as racism is among the explanations that have been forwarded to explain these persistently higher rates of hypertension in some Blacks (2–4). Consistent with the results of Anderson, McNeilly, and Myers (5), perceived racism may influence acute elevations in vascular reactivity, which is posited to lead over time to hyperreactivity, structural changes in the vasculature, baroreceptor alterations, and eventually hypertension. To the extent that perceptions of chronic stressors influence the development of these physiological changes (5), it may be possible to identify subgroups of individuals who are at increased risk of developing hypertension by examining observable differences in physiological stress responses. Individual differences in the magnitude and duration of these physiological stress responses are in turn hypothesized to depend on the availability and use of coping resources (6,7).

Social support is one coping resource that has been postulated to influence physiological functioning (8). Despite numerous conceptualizations of social support in the scientific literature, the term is generally used to refer to the number of members in one's social network who are available to provide assistance (quantity of social support, or SSN) or the perceived quality of assistance provided by members of the social network (quality of social support, or SSQ) (9,10). Although the mechanisms linking social support to health processes have not been explicated, Cohen and Wills (11) theorized that social support influences physiological systems directly or through its relationship to behavioral risk factors. Given research indicating that real-world experiences (e.g., perceived racism) are related to physiological responses to nonsocial laboratory tasks (12,13), it may be possible to identify patterned relations between these real-world experiences and coping resources (e.g., social support) that are associated with physiological stress responses to these nonsocial tasks (2).

Two models have been forwarded to explain the beneficial effects of social networks on health processes: (a) the main effect model and (b) the stress-buffering model (for reviews of this literature, see 8,11,14). According to the main effect model, the social support provided by social networks is salutogenic, regardless of the recipient's level of stress. The stress-buffering model, on the other hand, posits that the health-promoting effects of social support are primarily observed among individuals who are experiencing stress. Although a plethora of data has documented positive associations between social support (both SSQ and SSN) and health processes (8,11,14), a large body of literature either has failed to find significant relations between social support and health processes or has found aspects of social support to be related to more negative health processes (15–20).

At least two methodological approaches have been used to test the relation between social support and health processes (e.g., cardiovascular functioning). The first methodological approach involves the experimental manipulation of social contexts whereby participants are assigned to a condition (e.g., supportive, nonsupportive, confrontational, or neutral) with a stranger, friend, or animal, and physiological responses to an acute laboratory challenge are measured. With some exceptions (21,22), more recent research using this approach suggests that participants in supportive contexts with friends or strangers exhibit less marked physiological responses to acute laboratory

Preparation of this article was supported by Grant 1R03 MH56868–01 to Dr. Rodney Clark from the National Institute of Mental Health.

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challenges (23–32). Although this experimental design generally has higher internal validity than nonexperimental designs, the generalizability of the artificial social support manipulation to natural settings remains to be determined (11).

The second methodological approach, although not as well documented, involves the use of pre–post designs to examine the association of self-report assessments of perceived stress and social support to ambulatory blood pressure changes or physiological reactivity. For example, Steptoe (33) found that self-reported social support buffered the deleterious effects of perceived workday stress on ambulatory blood pressure and heart rate changes in a sample of schoolteachers. In another investigation, using standardized laboratory challenges, Uchino, Kiecolt-Glaser, and Cacioppo (34) found that self-reported social support moderated cardiovascular reactivity, especially among participants exposed to chronic stress. Although these findings are consistent with those from experimental studies, not all pre–post studies have supported the social support–reactivity hypothesis (35), which posits that social support is inversely related to cardiovascular reactivity. Even though many pre–post designs have lower internal validity relative to experimental designs, comparatively speaking, they generally have higher external validity. The probability of this threat to internal validity is a function, at least in part, of the extent to which alternate explanations are considered (i.e., exploring the effects of potential confounders).

Using a pre–post design, this investigation builds on the existing literature in at least three ways. First, instead of assessing either SSN or SSQ, both components of social support are measured in this study. Second, although a small but emerging empirical literature has started to document the association between racism-specific coping resources and indices of health (4,36–38), this study is perhaps the first to explore the relation of perceived racism and generalized perceptions of social support to blood pressure reactivity in a sample of Blacks. Finally, although some prior research exploring the relation between cardiovascular reactivity and perceived racism have used interpersonal and more social tasks (e.g., ethnically relevant speech, watching a videotape of an anger-provoking/ethnically relevant incident or debate) (e.g., 31,39), a relatively nonsocial task was used for two important reasons. First, although observed relations between cardiovascular responses and these interpersonal and more social tasks provide some insight into cardiovascular responses during markedly stressful stimuli, the generalizability of these findings to stimuli that do not result in a continued state of marked subjective distress (including perceptions of racism by some individuals) is more limited (12). Second, to the extent that perceptions of chronic stressors such as racism are related to longer term physiological changes that contribute to vascular hyperreactivity (2,5), differences in blood pressure should be observed in response to social and relatively nonsocial laboratory tasks. Furthermore, given that only two published studies have examined the relation between racism and cardiovascular reactivity—one by means of self-report (12) and the other by means of an ethnically relevant speaking task (40)—it would be premature to conclude that laboratory studies in this area should be limited to those using interpersonal or more social laboratory tasks. As such, the research questions for this exploratory investigation were as follows: (a) Are perceptions of racism and social support (SSN and SSQ) independent predictors of blood pressures reactivity, and (b) do perceived racism and social support (SSN and SSQ) interact to predict blood pressure reactivity?

METHOD

Participants

Sixty-four Black college volunteers participated in this study. All were free of serious self-reported psychological (e.g., major depression) and medical (e.g., hypertension) conditions. Data on the menstrual status of women were not collected. Volunteers were recruited through schoolwide advertisements and through established contacts with student groups. Participants were given research credit or were paid a monetary incentive of $15 for participating in the study. Participants were instructed not to drink cardioactive substances (e.g., cola) 12 hr prior to the laboratory session.

Questionnaires and Task

Demographics. A demographics questionnaire assembled for the purpose of this study included questions about age, socioeconomic status, family history of cardiovascular disease and hypertension, caffeine and alcohol intake, recreational drug use, and use of birth control medication. Height and weight measurements were also taken for later calculations of body mass index (BMI).

Perceived racism. A modified version of the 128-item Life Experiences and Stress Scale (41), based on a model of racism proposed by Harrell (42), was used to assess perceived racism. The modification included changing the racism involvement forced-choice question to an item that asked about racism involvement during the lifetime. A perceived racism composite (PRC) was derived by summing responses to the question "Overall, how much do you think that INTER-ETHNIC GROUP RACISM has had anything to do with any problem you have had related to your _____ in your lifetime?" Responses to this question spanned nine domains: (a) employment, (b) law enforcement and the legal system, (c) money and finances, (d) education, (e) community, (f) family and social relationships, (g) emotional well-being, (h) physical health and medical care, and (i) public assistance. Responses ranged from 0 (*less than 25% of the time*) to 4 (*between 75% and 100% of the time*), with possible average scores that ranged from 0 to 4. In this study, this nine-item composite had an internal alpha reliability of .76 and a split-half reliability of .75 ($p < .0001$). The item–total correlations ranged from .19 (law enforcement and the legal system) to .60 (physical health and medical care), with an average of .39. Correlation analyses revealed that the PRC was moderately related ($r = .42$, $p < .0007$) to a psychometrically stable 9-item measure of vicarious and direct racism (Racism and Life Experience Scales—Brief version [43,44]). Correlation analyses also indicated that the PRC was positively related to the

self-medicating (alcohol) coping subscale of the COPE ($r = .25$, $p < .05$ [45]) and was unrelated to the Self-Deceptive Enhancement and Impression Management subscales of the Balanced Inventory of Desirable Responding ($ps > .05$ [46]).

Social support. SSN and SSQ were measured with the 6-item Sarason Social Support Scale—Brief (10). Each item had two parts. The first part assessed SSN and asked for a listing of people (a maximum of nine) able to provide assistance for a given issue (e.g., "Who can you really count on to distract you from your worries when you feel under stress?"). The possible average social support/number scores ranged from 0 to 9. The second part of each item measured SSQ and inquired about the satisfaction derived from the aforementioned list of people (as a group). Responses ranged from 1 (*very dissatisfied*) to 6 (*very satisfied*), with possible mean social support/quality scores that ranged from 1 to 6. Sarason et al. (10) found that the internal alpha reliabilities of the SSN and SSQ subscales ranged from .90 to .93 and that the subscales had adequate construct validity. In this study, the SSN and SSQ subscales had internal alpha reliabilities of .90 and .96, respectively. The item–total correlations for the SSN subscale ranged from .67 to .77 ($M = .73$), and the item–total correlations for the SSQ subscale ranged from .81 to .93 ($M = .87$). To explore the generalizability of the component structures of the SSN and SSQ subscales, a principal components analysis, using a varimax rotation, was used to force a two-component solution. The results of this analysis revealed that the SSN items had clear loadings on Factor 1 (all loadings on this factor were > .76), with small to negligible loadings on Factor 2 (all loadings on this factor were < .21). Similarly, the SSQ items had clear loadings on Factor 2 (all loadings on this factor were > .85), with small to negligible loadings on Factor 1 (all loadings on this factor were < .14). Furthermore, correlation analyses revealed that SSN and SSQ were not significantly related ($r = .19$, $p > .14$). Together, these analyses indicated the SSN and SSQ subscales represented different components of social support.

Laboratory task. A standardized serial subtraction task was used to elicit blood pressure responses. As Clark (12) suggested, the use of a laboratory task that is devoid of ethnicity per se may extend the generalizability of the findings to blood pressure reactivity to environmental stressors that are not racism specific.

Apparatus

An automated Tango Portable Blood Pressure Monitor (SunTech 4240, SunTech Inc., Raleigh, NC) was used to measure systolic blood pressure (SBP) and diastolic blood pressure (DBP) from the upper portion of the participant's nondominant arm. This noninvasive procedure uses an oscillometric transducer and has been shown to be a valid measure of blood pressure (47). Furthermore, comparative assessments between the SunTech 4240 and the mercury sphygmomanometric method indicate that the SunTech 4240 reliably measures resting blood pressure and reactivity (48).

Procedure

After questions about the study were addressed, informed consent was obtained, and the questionnaire packet was returned. Participants were instructed to sit quietly for 5 min, after which baseline blood pressure measurements were taken. Baseline consisted of a 10-min period during which blood pressure activity was measured every other minute during the last 5 min. The first baseline reading was taken 5 min into the period, and the last reading was taken 9 min into the period (three total readings). After baseline, the experimenter returned to the participant room and handed the participant a clipboard with a stimulus sheet. The participant was told that a tape-recorded message would be played that would explain the serial subtraction task. These standardized instructions informed the participant to start with the number 1,650 and to begin subtracting by 13. The recorded message further instructed participants to say their responses aloud and to work as quickly and accurately as possible for the next 3 min and explained that at the end of the study the participant who had given the most accurate responses would receive $20. If participants stopped responding before the allotted 3 min had elapsed, they were prompted by the experimenter to continue with the task until cued to stop. Throughout the task period, blood pressure readings were measured every minute. The first reading was taken 30 sec into the period, and the last reading was taken 2.5 min into the period (three total readings). Other than the experimenter, who observed the participant through a two-way mirror in an adjacent room, an audience was not present during the task. The four female experimenters who gathered data for this study self-identified as being Black or African American.

Data Reduction and Analyses

Predictor variables. The raw scores for the PRC, SSN, and SSQ scores were converted to standardized scores. These standardized scores were the primary predictor variables of interest in the regression models. The PRC × SSN and PRC × SSQ interaction terms were created by multiplying the relevant standardized scale scores.

Criterion variables. Throughout the 3-min task period, SBP and DBP readings were averaged separately to obtain the participant's reactivity level. Change scores (task level – baseline level) for the reactivity period were calculated and used as the criterion variables in the multiple regression analyses. Because baseline levels could influence change scores, all regression models included the baseline blood pressure level as the control variable—a statistical approach consistent with the data analytic procedure of Chen and Matthews (49).

Analyses. All statistics were computed using SAS (50). To examine the effects of perceived racism and social support on blood pressure changes, four multiple regression analyses were

conducted. In each analysis, the baseline blood pressure value (SBP or DBP) was entered into the model first, PRC was entered into the model second, either SSN or SSQ was entered third, and the PRC × SSN or PRC × SSQ interaction term was entered fourth. Because of missing values for some of the predictor variables, data from only 60 or 61 participants were included in the regression analyses. *T*-test analyses revealed that participants who were included in the regression analyses did not differ significantly on any of the criterion variables, relative to the 3 or 4 participants who were not included in the analyses (all *p*s > .05). Given that each set of predictors was used to predict both components of blood pressure (e.g., PRC, SSN, and PRC × SSN predicting SBP changes, and PRC, SSN, and PRC × SSN predicting DBP changes), a Bonferroni correction was used to minimize spurious findings. As such, $p < .025$ (i.e., .05/2) was the criterion of statistical significance for the parameter estimates in each model.

RESULTS

Univariate and Bivariate Analyses

The mean age of the sample was 22.69 years (*SD* = 6.60), the average BMI was 25.67 kg/m^2 (*SD* = 4.69), and 72.3% of the sample was female. Thirty-six percent of the sample (n = 23) had a positive family history of hypertension, and 16.1% of the women (n = 8) were taking birth control medication. The mean baseline SBP (116.73 mmHg, *SD* = 9.00) and DBP (65.54 mmHg, *SD* = 5.26) levels were within normal limits. On average, the sample consumed 4.85 caffeine drinks per week (*SD* = 4.32), and 3.08% (n = 2) used recreational drugs. The mean PRC score was 0.99 (*SD* = 0.66, observed range = 0–2.89), with 4 participants (all women) reporting no perceptions of racism. The average number of social supports was 3.39 (*SD* = 1.93, observed range = 0.17–8.33), and the mean SSQ value was 5.09 (*SD* = 1.29, observed range = 1.00–6.00).

The results of correlation analyses among select study variables are shown in Table 1. Whereas baseline DBP was positively related to age, baseline SBP was inversely related to SSQ and positively related to cigarettes per day (all *p*s < .05). Regarding the primary predictor variables of interest, SSN was inversely related to BMI ($p < .01$) and positively associated with household income per person ($p \leq .05$). In addition, PRC was inversely related to SSN ($p < .05$).

Racism, Social Support, and Changes in SBP

As shown in Table 2, two multiple regression models were used to examine the relation of perceived racism and social support to SBP changes. In Model 1, the omnibus *F* statistics for Step 1 (entry of PRC), Step 2 (entry of SSN), and Step 3 (entry of PRC × SSN) were not significant (*p*s > .65, .58, and .07, respectively). In Step 3, however, the PRC × SSN parameter estimate was significant, $F(1, 57) = 2.63$, $p < .02$, accounting for 11% of variability in SBP changes. To explore this interaction effect, two additional models were computed regressing SSN on SBP changes for groups low (n = 35) and high (n = 25) in perceived racism (created by means of a median split). The findings indicated that although SSN was not significantly related to SBP changes for participants in the low-PRC group, $F(1, 34) = 1.46$, $p > .23$, SSN was positively related to SBP changes for participants in the high-PRC group, $F(1, 24) = 10.83$, $p < .004$. To illustrate this interaction effect, high and low groups were created (by means of median splits) for PRC

TABLE 1
Correlation Analyses Among Selected Study Variables

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1. Age	—													
2. Body mass index	.33*	—												
3. Caffeine drinks/week	.00	.16	—											
4. Household income	–.04	.00	.12	—										
5. Household income/person	–.10	–.11	.12	.28*	—									
6. Subjective anxiety	.01	.04	.09	–.02	–.20	—								
7. Subjective stress	.02	.23	.03	–.05	–.02	.11	—							
8. SSQ	.00	–.05	–.05	.00	.17	.15	.08	—						
9. SSN	.02	–.33**	.14	–.08	.27*	–.15	.01	.19	—					
10. PRC	–.01	.04	–.15	.06	–.01	–.25	.23	–.10	–.34**	—				
11. Cigarettes/day	.02	.00	–.12	.13	.10	–.02	.11	–.33**	.13	–.17	—			
12. Systolic blood pressure (baseline)	.18	.13	.01	.09	–.16	.03	–.09	–.25*	.03	–.11	.25*	—		
13. Diastolic blood pressure (baseline)	.42***	–.06	.07	.14	.10	.07	–.07	–.18	.03	.04	.17	.30*	—	
14. Family history of hypertension[a]	.05	.14	–.15	–.29*	–.18	–.09	.22	.08	–.07	.21	–.10	–.05	–.14	—

Note. SSQ = quality of social support; SSN = quantity of social support; PRC = perceived racism composite.
[a]Range is 0 (*neither parent*) to 1 (*one parent*) to 2 (*both parents*).
*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 2
Multiple Regression Analyses Predicting Systolic Blood Pressure Changes During a Serial Subtraction Task

Criterion/Predictor	*Step 1*	*Step 2*	*Step 3*
Model 1			
PRC	–1.12	–1.30	–.07
SSN	—	.79	1.76
PRC × SSN	—	—	3.07*
R^2	.014	.034	.144
F	.43	.64	2.27
p	> .65	> .58	> .07
Model 2			
PRC		–1.25	–1.35
SSQ		1.19	.98
PRC × SSQ		—	1.44
R^2		.051	.068
F		.96	.96
p		> .41	> .43

Note. Separate regression models were used to predict systolic blood pressure changes during the reactivity period for each of the social support variables, controlling for the effects of baseline systolic blood pressure. Table values are unstandardized parameter estimates. Dashes indicate that the variable was not entered in that step. PRC = perceived racism composite; SSN = quantity of social support; SSQ = quality of social support.

*Parameter estimate significant at $p < .025$.

and SSN. SBP changes for participants in the low-PRC/low-SSN ($n = 12$; $M = 12.08$ mmHg), high-PRC/low-SSN ($n = 19$; $M = 5.95$ mmHg), low-PRC/high-SSN ($n = 25$; $M = 9.64$ mmHg), and high-PRC/high-SSN ($n = 9$; $M = 12.41$ mmHg) groups are shown in Figure 1. Findings from the multiple regression model examining the relation of perceived racism and SSQ (Model 2) revealed that Step 2 (entry of SSQ) and Step 3 (entry of PRC × SSQ) failed to significantly predict changes in SBP (*p*s > .41 and .43, respectively). In the final step, none of the individual parameter estimates reached statistical significance.

Racism, Social Support, and Changes in DBP

Two multiple regression models were also used to examine the relation of perceived racism and social support to DBP changes (see Table 3). In Model 1, the omnibus *F* statistics for Step 1 (entry of PRC) and Step 2 (entry of SSN) were not significant (*p*s > .86 and .94, respectively). The omnibus *F* statistic was significant ($p < .027$) in Step 3, however, when the PRC × SSN interaction term was added. The parameter estimate associated with this interaction term was significant ($p < .002$), accounting for 17.5% of unique variability in DBP changes. To explicate the pattern of associations between PRC and SSN, two additional models were computed regressing SSN onto DBP changes for groups low ($n = 35$) and high ($n = 25$) in perceived racism (created by means of a median split). These analyses indicated that SSN was

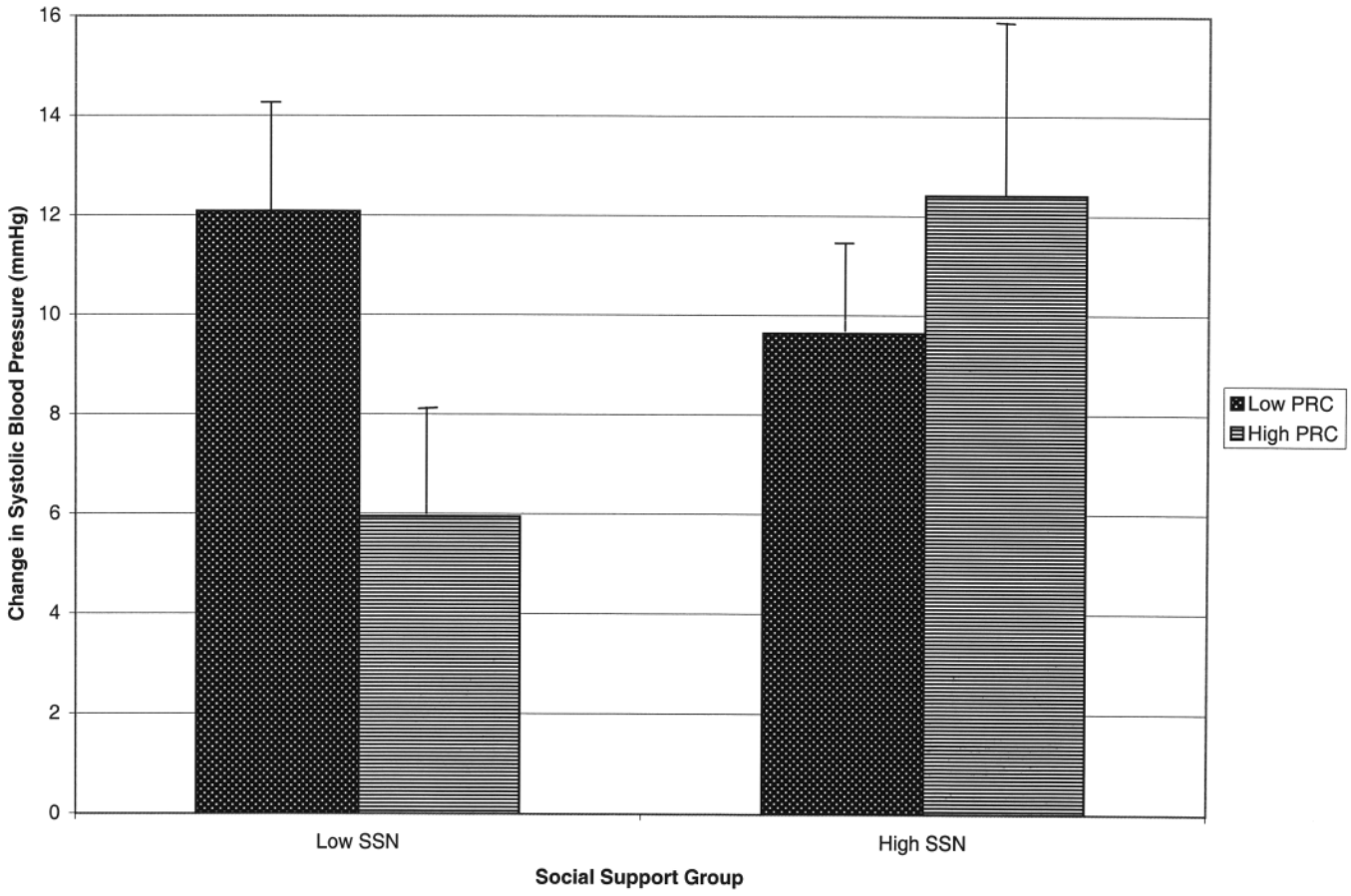

FIGURE 1 Mean (±*SE*) changes in systolic blood pressure as a function of perceived racism (PRC) and quantity of social support (SSN).

TABLE 3
Multiple Regression Analyses Predicting Diastolic Blood Pressure Changes During a Serial Subtraction Task

Criterion/Predictor	*Step 1*	*Step 2*	*Step 3*
Model 1			
PRC	.33	–.11	1.11
SSN	—	–.17	.72
PRC × SSN	—	—	2.87*
R^2	.005	.006	.181
F	.15	.12	2.98
p	> .86	> .94	< .027
Model 2			
PRC		–.22	–.22
SSQ		.66	.45
PRC × SSQ		—	3.53*
R^2		.019	.214
F		.36	3.61
p		> .78	< .02

Note. Separate regression models were used to predict diastolic blood pressure changes during the reactivity period for each of the social support variables, controlling for the effects of baseline diastolic blood pressure. Table values are unstandardized parameter estimates. Dashes indicate that the variable was not entered in that step. PRC = perceived racism composite; SSN = quantity of social support; SSQ = quality of social support.

*Parameter estimate significant at $p < .025$.

negatively related to DBP changes for participants in the low-PRC group, $F(1, 34) = 4.27$, $p < .05$, and was positively related to DBP changes for participants in the high-PRC group, $F(1, 24) = 11.27$, $p < .003$. To illustrate this interaction effect, high and low groups were created (by means of median splits) for PRC and SSN. DBP changes for participants in the low-PRC/low-SSN ($n = 12$; $M = 10.08$ mmHg), high-PRC/low-SSN ($n = 19$; $M = 6.98$ mmHg), low-PRC/high-SSN ($n = 25$; $M = 6.28$ mmHg), and high-PRC–high-SSN ($n = 9$; $M = 11.15$ mmHg) groups are shown in Figure 2.

In Model 2, whereas the omnibus *F* statistic for Step 2 (entry of SSQ) was not significant ($p > .71$), the omnibus *F* statistic for Step 3 (entry of PRC × SSQ) was significant ($p < .02$). The parameter estimate for this interaction term was significant ($p < .0007$), accounting for an additional 19.5% of variability in DBP changes. Two additional analyses regressing SSQ onto DBP changes for groups low ($n = 33$) and high ($n = 25$) in perceived racism were computed to interpret the interaction term. Although these analyses revealed that there was not a significant association between SSQ and DBP changes for participants in the low-PRC group, $F(1, 33) = 2.15$, $p > .15$, SSQ was positively related to DBP changes for participants in the high-PRC group, $F(1, 24) = 8.90$, $p < .007$. To illustrate this interaction effect, high and low groups were once again created (by means of median splits) for PRC and SSQ.

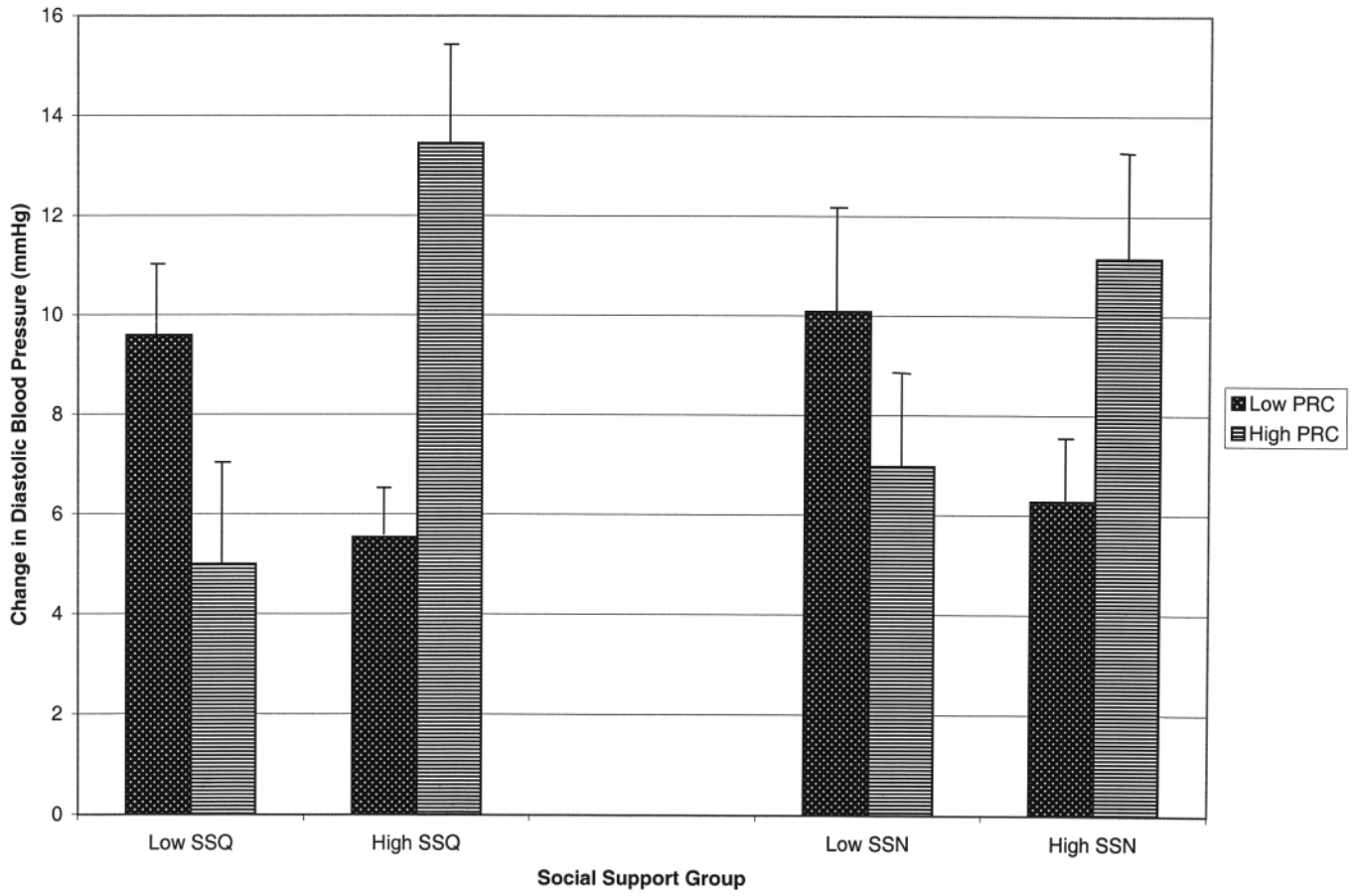

FIGURE 2 Mean (±*SE*) changes in DBP as a function of perceived racism (PRC), quantity of social support (SSN), and quality of social support (SSQ).

DBP changes for participants in the low-PRC/low-SSQ (n = 18; M = 9.59 mmHg), high-PRC/low-SSQ (n = 17; M = 5.00 mmHg), low-PRC/high-SSQ (n = 19; M = 5.54 mmHg), and high-PRC/high-SSQ (n = 11; M = 13.45 mmHg) groups are also shown in Figure 2.

Tests of Potential Mitigating Factors

Additional regression analyses were conducted to determine whether the potentially confounding effects of age (years), BMI (kg/m^2), gender (male or female), family history of hypertension (0 = neither parent, 1 = one parent, 2 = both parents), use of birth control medication (yes or no), use of prescription drugs (other than birth control; yes or no), use of recreational drugs (e.g., marijuana; yes or no), cigarettes per day (continuous), caffeine drinks per week (continuous), household income (interval), household income per person in the household (continuous), positive and negative affect (continuous), trait anger and anger expression (continuous), anxiety response to the serial subtraction task (continuous analog rating), perceived stressfulness of the serial subtraction task (continuous analog rating), SSN (in the model testing the PRC × SSQ effect), and SSQ (in the model testing the PRC × SSN effect) mitigated the aforementioned relations among perceived racism, social support, and blood pressure changes. The 19 potential confounders were tested separately (i.e., one at a time) in four regression analyses. In the first set of analyses, baseline blood pressure (SBP in Analysis 1 and DBP in Analysis 2) was entered in Step 1, the potential confounder was entered in Step 2, PRC was entered in Step 3, SSN was entered in Step 4, and PRC × SSN was entered in Step 5. In the second set of analyses, baseline blood pressure (SBP in Analysis 1 and DBP in Analysis 2) was entered in Step 1, the potential confounder was entered in Step 2, PRC was entered in Step 3, SSQ was entered in Step 4, and PRC × SSQ was entered in Step 5. Every analysis revealed that, beyond the effects of each potential confounder, the PRC × SSN and PRC × SSQ interaction terms were still significant predictors ($p < .025$) in the models predicting DBP changes, and the PRC × SSN interaction term was still a significant predictor in the model predicting changes in SBP.

An alternate approach to the one delineated earlier would have involved examining the bivariate relations among these potential confounders and blood pressure changes and including only those potential confounders in the regression analyses that were statistically related ($p < .10$) to blood pressure changes. These bivariate analyses revealed that the perceived stressfulness of the serial subtraction task was positively related to changes in DBP and that household income was positively related to changes in SBP (both ps < .05). As noted previously, however, including these control variables in their respective regression models did not mitigate the observed social support/blood pressure change relations.

Post Hoc Analyses

Given that the low-racism group actually included 4 participants who reported not perceiving racism, it is probable that the social networks of these participants were qualitatively and quantitatively different from the other participants in this group. As such, the PRC/social support/blood pressure analyses in Table 2 (Model 1) and Table 3 (Model 1 and Model 2) were re-examined, excluding the 4 participants who did not report perceiving racism. The results revealed that the PRC × SSN finding, $F(1, 53) = 3.11$, $p < .004$, in Table 2, as well as the PRC × SSQ, $F(1, 52) = 3.79$, $p < .0004$, and PRC × SSN, $F(1, 53) = 3.72$, $p < .00$, findings in Table 3, remained significant.

DISCUSSION

This study examined the relation of perceived racism and social support to blood pressure reactivity in Black college volunteers. Although the mean PRC of .99 (out of a possible 4.00) might appear low, it translates into the perception that the important areas of one's life have been influenced by racism at least 25% of the time. This level of perceived exposure is consistent with levels found in other studies of Black adults using different measures of racism (51,52) and underscores the need for further exploration of the psychological and physical effects of this persistent stressor. To the extent that the frequency of these perceived exposures varies by gender, the gender composition in this study (primarily female) may have influenced reports of overall exposure as well as exposures in specific areas of life. For example, amid research suggesting that Black men and women perceive equal amounts of racism (53), most investigations indicate that Black men perceive more racism than Black women (52–56). Furthermore, as Krieger, Sidney, and Coakley observed (54), the men in this study perceived significantly more racism in the area of law enforcement and the legal system (data not shown) than did the women. Additional research with Blacks is needed that examines the relative psychological and physiological impact of racism perceived across different areas of life.

Similar to other reports (24–31), and consistent with the social–support reactivity hypothesis, the findings from this study revealed that social support was associated with less marked changes in blood pressure. This pattern of association was observed, however, only among participants who perceived low amounts of racism (which included 4 participants who reported not perceiving racism). Conversely, among participants who perceived high amounts of racism, social support was positively related to blood pressure reactivity. The direction of this racism/social support relation to blood pressure changes was similar regardless of whether social support was assessed as a function of the number of supports or the quality of supports—assessments that were statistically independent.

Regarding the interaction effects of perceived racism and social support, it is probable that larger or highly satisfying social networks communicate a sense of hopelessness or self-blame as reports of racism become more frequent, thereby leading to the use of less adaptive health-related behaviors (e.g., smoking) (57) and to the use of more deleterious coping resources (e.g., accepting it, projection, and avoidance) (36). To the extent that individuals feel more comfortable socializing with and seeking support from others who have had similar stress-related experiences (in this case, perceptions of racism),

these social networks may also facilitate ongoing discussions and ruminations about said experiences, resulting in continued cardiovascular activation.

Alternatively, in response to relatively discrete perceptions of racism, larger or highly satisfying networks may provide an expansive forum that facilitates the establishment and use of coping resources that are more "adaptive." For example, individuals who are encouraged by social networks to use emotional distancing to cope with the untoward effects of relatively discrete perceptions of racism (i.e., do not recur or do not recur often) would not be expected to (or continue to) perceive these environmental events as threatening or harmful and, as a result, physiological stress responses would not be expected to follow (or persist). In response to more discrete perceptions of racism, it is also probable that these larger or highly satisfying networks help to reduce the magnitude and duration of physiological stress responses by providing diffuse support and facilitating a sense of belongingness, thereby leading to more positive mood states and a needed distraction from the noxious stimulus (9). Directions for future research include explicating the relation of different types of support and more real-world experiences to cardiovascular functioning. For example, whereas instrumental support may be a more effective coping response to person–environment interactions that give rise to chronic perceptions of racism that are beyond the control of the individual (e.g., some forms of institutional racism), this same mechanism of support may not have the same buffering effects in response to chronic perceptions of cultural racism.

Similar to findings from the other two studies that explored the relation between perceived racism and blood pressure reactivity (12,40), statistically significant findings were observed most consistently with respect to changes in DBP. Consistent with these findings, Fang and Myers (58) found that indirect exposure to racism (film excerpts) was associated with significant reactivity and prolonged recovery for DBP but not SBP. Although the omnibus *F* statistic was not statistically significant in the model where the interactive effects of perceived racism and the SSN predicted changes in SBP, the pattern of findings was similar to those observed in the models predicting changes in DBP. As such, an alternate explanation of the findings is that the interactive effects of racism and the SSN are most predictive of blood pressure changes. If the major contributors to DBP and SBP include peripheral resistance and cardiac output, respectively (59), then the interaction of more real-world experiences, such as social support and perceived racism, may contribute to observable differences in alpha-adrenergic sympathetic activity (primarily) and beta-adrenergic sympathetic activity (secondarily) (12,60). Because peripheral resistance and cardiac output were not assessed in this study, this post hoc explanation is at best speculative. Future studies exploring additional indices of cardiovascular functioning (e.g., cardiac output, total peripheral resistance, and arterial elasticity) may provide a more informed understanding of the processes that underlie blood pressure reactivity. This line of future research would be particularly edifying given research showing the predictive utility of DBP reactivity to future DBP changes (61) on one hand and other studies indicating the prognostic significance of SBP but not DBP reactivity (62,63) on the other hand.

In spite of the relative consistency of the findings observed in this study, the results should be interpreted in light of certain methodological caveats. First, the relatively small sample size precluded adequate tests of effects that may have further delineated the interactive effects of racism and social support on blood pressure variability (e.g., SSQ × SSN × Racism). Second, the pre–post design of the current investigation precluded causal interpretations of the relation of perceived racism and social support to blood pressure variability. Longitudinal studies exploring associations among perceived racism, coping resources, and ambulatory blood pressure are needed. Third, because the sample was restricted to Black college volunteers (primarily female) from a large metropolitan area, the findings may not generalize to other ethnic, socioeconomic, and demographic groups. Fourth, although the measure of perceived racism that was created for the purpose of this investigation appeared to have adequate reliability and showed some evidence of convergent and concurrent validity, additional research exploring the psychometric properties of this measure is warranted. Finally, although the mitigating effects of numerous potential confounders were examined in post hoc analyses, an overly simplified interpretation of the results may have resulted from the failure to assess the potential confounding effects of other variables (e.g., menstrual cycle phase and perceived control). These limitations notwithstanding, the findings from this study highlight the importance of examining the joint contribution of real-world experiences and coping resources to blood pressure reactivity (64,36), which may have long-term implications for intra-ethnic group health disparities in Blacks (2).

REFERENCES

(1) National Center for Health Statistics: *Health, United States, 1998 With Socioeconomic Status and Health Chartbook*. Hyattsville, MD: U.S. Government Printing Office, 1998.

(2) Clark R, Anderson NB, Clark VR, Williams DR: Racism as a stressor for African Americans: A biopsychosocial model. *American Psychologist.* 1999, *54*:805–816.

(3) Harrell JP, Merritt MM, Kalu JK: Racism, stress, and disease. In Jones RL (ed), *African American Mental Health*. Hampton, VA: Cobb and Henry, 1998, 247–280.

(4) Krieger N, Sidney S: Racial discrimination and blood pressure: The CARDIA Study of young Black and White adults. *American Journal of Public Health.* 1996, *86*:1370–1378.

(5) Anderson NB, McNeilly M, Myers H: Autonomic reactivity and hypertension in Blacks: A review and proposed model. *Ethnicity & Disease.* 1991, *1*:154–170.

(6) Burchfield SR: The stress response: A new perspective. *Psychosomatic Medicine.* 1979, *41:*661–672.

(7) Lazarus RS, Folkman S: *Stress, Appraisal, and Coping*. New York: Springer, 1984.

(8) Lepore SJ: Problems and prospects for the social support–reactivity hypothesis. *Annals of Behavioral Medicine.* 1998, *20*:257–269.

(9) Dressler WW: Social support, lifestyle incongruity, and arterial blood pressure in a Southern Black community. *Psychosomatic Medicine*. 1991, *53*:608–620.

(10) Sarason IG, Sarason BR, Shearin EN, Pierce GR: A brief measure of social support: Practical and theoretical implications. *Journal of Social and Personal Relationships.* 1987, *4*:497–510.
(11) Cohen S, Wills TA: Stress, social support, and the buffering hypothesis. *Psychological Bulletin.* 1985, *96*:310–357.
(12) Clark R: Perceptions of inter-ethnic group racism predict increased blood pressure responses to a laboratory challenge in college women. *Annals of Behavioral Medicine.* 2000, *22*:214–222.
(13) Roy MP, Steptoe A, Kirschbaum C: Life events and social support as moderators of individual differences in cardiovascular and cortisol reactivity. *Journal of Personality and Social Psychology.* 1998, *75*:1273–1281.
(14) Uchino BN, Cacioppo JT, Kiecolt-Glaser JK: The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin*. 1996, *119*:488–531.
(15) Anthony JL, O'Brien WH: An evaluation of the impact of social support manipulations on cardiovascular reactivity to laboratory stressors. *Behavioral Medicine*. 1999, *25*:78–87.
(16) Daniels A, Hoffman M, Lombard C, et al.: Blood pressure and social support observations from Mamre, South Africa, during social and political transition. *Journal of Human Hypertension*. 1999, *13*:689–693.
(17) Evan O, Steptoe A: Social support at work, heart rate, and cortisol: A self-monitoring study. *Journal of Occupational Health Psychology.* 2001, *6*:361–370.
(18) Liang J, Krause NM, Bennett JM: Social exchange and well-being: Is giving better than receiving? *Psychology and Aging*. 2001, *16*:511–523.
(19) Rook KS: The negative side of social interaction: Impact on psychological well-being. *Journal of Personality and Social Psychology.* 1984, *46*:1097–1108.
(20) Vitaliano PP, Scanlan JM, Zhang J, et al.: Are the salutogenic effects of social supports modified by income? A test of an "added value hypothesis." *Health Psychology.* 2001, *20*:155–165.
(21) Stansfeld SA, Fuhrer R, Shipley MJ: Types of social support as predictors of psychiatric morbidity in a cohort of British civil servants (Whitehall II Study). *Psychology and Medicine*. 1998, *28*:881–892.
(22) Anthony JL, O'Brien WH: An evaluation of the impact of social support manipulations on cardiovascular reactivity to laboratory stressors. *Behavioral Medicine.* 1999, *25*:78–87.
(23) Craig FW, Lynch JJ, Quartner JL: The perception of available social supports is related to reduced cardiovascular reactivity in Phase II cardiac rehabilitation patients. *Integrative Physiological and Behavioral Science.* 2000, *35*:272–283.
(24) Christenfeld N, Gerin W, Linden W, et al.: Social support effects on cardiovascular reactivity: Is a stranger as effective as a friend? *Psychosomatic Medicine.* 1997, *59*:388–398.
(25) Fontana AM, Diegnan T, Villeneuve A, Lepore SJ: Nonevaluative social support reduces cardiovascular reactivity in young women during acutely stressful performance situations. *Journal of Behavioral Medicine.* 1999, *22*:75–91.
(26) Gallo LC, Smith TW, Kircher JC: Cardiovascular and electrodermal responses to support and provocation: Interpersonal methods in the study of psychophysiological reactivity. *Psychophysiology.* 2000, *37*:289–301.
(27) Gerin W, Milner D, Chawla S, Pickering TG: Social support as a moderator of cardiovascular reactivity in women: A test of the direct effects and buffering hypotheses. *Psychosomatic Medicine.* 1995, *57*:16–22.
(28) Kamarck TW, Annunziato B, Amateau LM: Affiliation moderates the effects of social threat on stress-related cardiovascular responses: Boundary conditions for a laboratory model of social support. *Psychosomatic Medicine.* 1995, *57*:183–194.
(29) Kamarck TW, Manuck SB, Jennings JR: Social support reduces cardiovascular reactivity to psychologic challenge: A laboratory model. *Psychosomatic Medicine.* 1990, *52*:42–58.
(30) Lepore SJ, Allen KA, Evans GW: Social support lowers cardiovascular reactivity to an acute stressor. *Psychosomatic Medicine.* 1993, *55*:518–524.
(31) McNeilly MD, Robinson EL, Anderson NB, et al.: Effects of racist provocation and social support on cardiovascular reactivity in African American women. *International Journal of Behavioral Medicine.* 1995, *2*:321–338.
(32) Christenfeld N, Gerin W: Social support and cardiovascular reactivity. *Biomedicine and Pharmacotherapy.* 2000, *54*:251–257.
(33) Steptoe A: Stress, social support and cardiovascular activity over the working day. *International Journal of Psychophysiology.* 2000, *37*:299–308.
(34) Uchino BN, Kiecolt-Glaser JK, Cacioppo JT: Age-related changes in cardiovascular response as a function of a chronic stressor and social support. *Journal of Personality and Social Psychology.* 1992, *63*:839–846.
(35) Boyce WT, Chesterman E: Life events, social support, and cardiovascular reactivity in adolescence. *Journal of Developmental and Behavioral Pediatrics.* 1990, *11*:105–111.
(36) Clark R, Anderson NB: Efficacy of racism-specific coping styles as predictors of cardiovascular functioning. *Ethnicity & Disease.* 2001, *11*:286–295.
(37) Clark VR, Harrell JP: The relationship among Type A behavior, styles used in coping with racism, and blood pressure. *Journal of Black Psychology.* 1982, *8*:89–99.
(38) Williams DR, Yu Y, Jackson J, Anderson N: Racial differences in physical and mental health: Socioeconomic status, stress and discrimination. *Journal of Health Psychology.* 1997, *2*:335–351.
(39) Armstead CA, Lawler KA, Gorden G, et al.: Relationship of racial stressors to blood pressure responses and anger expression in Black college students. *Health Psychology.* 1989, *8*:541–556.
(40) Guyll M, Matthews KA, Bromberger JT: Discrimination and unfair treatment: Relationship to cardiovascular reactivity among African American and European American women. *Health Psychology.* 2001, *20*:315–325.
(41) Harrell SP: The Racism and Life Experiences Scales (RaLES). Unpublished instrument. Los Angeles: California School of Professional Psychology, 1997.
(42) Harrell SP: A multidimensional conceptualization of racism-related stress: Implications for the well-being of people of color. *American Journal of Orthopsychiatry.* 2000, *70*:42–57.
(43) Harrell SP: Development and initial validation of scales to measure racism-related stress. 6th Biennial Conference on Community Research and Action, Society for Community Research and Action (Division 27 of the American Psychological Association). Columbia, SC: 2000.
(44) Harrell SP, Merchant, MA, Young SA: Psychometric properties of the Racism and Life Experience Scales (RaLES). 105th Annual Convention of the American Psychological Association. Chicago: 1997.

(45) Carver DP, Scheier MF, Weintraub JK: Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology.* 1989, *56*:267–283.
(46) Paulhus DL: *BIDR Reference Manual for Version 6*. Vancouver, British Columbia, Canada: University of British Columbia, 1991.
(47) Mueller UK, Wells M, Radevski I, et al.: Repeated automated versus daytime ambulatory blood pressure measurement in mild, moderate, and severe untreated Black hypertensive patients. *Blood Pressure Monitoring.* 1997, *2*:21–25.
(48) Taylor RS, Gallen I: Evaluation of SunTech 4240 during rest and during exercise: A novel automated blood pressure device. *Journal of Cardiopulmonary Rehabilitation.* 1994, *14*:330.
(49) Chen E, Matthews KA: Cognitive appraisal biases: An approach to understanding the relation between socioeconomic status and cardiovascular reactivity in children. *Annals of Behavioral Medicine*. 2001, *23*:101–111.
(50) SAS Institute, Inc: *SAS System for Windows, Release 8.02*. Cary, NC: Author, 2001.
(51) Fischer AR, Shaw CM: African Americans' mental health and perceptions of racist discrimination: The moderating effects of racial socialization experiences and self-esteem. *Journal of Counseling Psychology.* 1999, *46*:395–407.
(52) Forman TA, Williams DR, Jackson JS: Race, place, and discrimination. *Social Problems.* 1997, *9*:231–261.
(53) Landrine H, Klonoff EA: The Schedule of Racist Events: A measure of racial discrimination and a study of its negative physical and mental health consequences. *Journal of Black Psychology.* 1996, *22*:144–168.
(54) Krieger N, Sidney S, Coakley E: Racial discrimination and skin color in the CARDIA Study: Implications for public health research. *American Journal of Public Health.* 1998, *88*:1308–1313.
(55) Sigelman L, Welch S: *Black Americans' Views of Racial Inequality: The Dream Deferred*. New York: Cambridge University Press, 1991.
(56) Klonoff EA, Landrine H: Cross-validation of the Schedule of Racist Events. *Journal of Black Psychology.* 1999, *25*:231–254.
(57) Romano PS, Bloom J, Syme SL: Smoking, social support, and hassles in an urban African-American community. *American Journal of Public Health*. 1991, *81*:1415–1422.
(58) Fang CY, Myers HF: The effects of racial stressors and hostility on cardiovascular reactivity in African American and Caucasian men. *Health Psychology.* 2001, *20*:64–70.
(59) Brunner LS, Suddarth DS: Conditions of the cardiovascular system. In *The Lippincott Manual of Nursing Practice*. Philadelphia: Lippincott, 1974, 349.
(60) Anderson NB: Racial differences in stress-induced cardiovascular reactivity and hypertension: Current status and substantive issues. *Psychological Bulletin.* 1989, *105*:89–105.
(61) Light KC, Girdler SS, Sherwood A, et al.: High stress responsivity predicts later blood pressure only in combination with positive family history and high life stress. *Hypertension.* 1999, *33*:1458–1464.
(62) Kurl S, Laukkanen JA, Rauramaa R, et al.: Systolic blood pressure to exercise stress test and risk of stroke. *Stroke.* 2001, *32*:2036–2041.
(63) Everson SA, Lynch JW, Kaplan GA, et al.: Stress-induced blood pressure reactivity and incident stroke in middle-aged men. *Stroke.* 2001, *32*:1263–1270.
(64) Clark R, Adams J, Clark VR: Effects of John Henryism and anger–coping on mean arterial pressure changes in African American females. *International Journal of Behavioral Medicine.* 2001, *8:*271–282.