Racism and Ambulatory Blood Pressure in a Community Sample

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Objective: Racism has been identified as a psychosocial stressor that may contribute to disparities in the prevalence of cardiovascular disease. The goal of the present article was to investigate the relationship of perceived racism to ambulatory blood pressure (ABP) in a sample of American-born Blacks and Latinos. **Methods:** Participants included English-speaking Black or Latino(a) adults between the ages of 24 and 65. They completed daily mood diaries and measures of perceived racism, socioeconomic status, and hostility. Participants were outfitted with ABP monitors; 357 provided data on waking hours only, and 245 provided data on both waking and nocturnal ABP. **Results:** Perceived racism was positively associated with nocturnal ABP even when controlling for personality factors and socioeconomic status. **Conclusions:** The results suggest that racism may influence cardiovascular disease risk through its effects on nocturnal BP recovery. **Key words:** ambulatory blood pressure, racism, discrimination, cardiovascular disease, ecological momentary assessment, hypertension.

ABP = ambulatory blood pressure; **SBP** = systolic blood pressure; **DBP** = diastolic blood pressure; **CVD** = cardiovascular disease; **SES** = socioeconomic status; **HTN** = hypertension; **AHA** = American Heart Association; **GHI** = gross household income; **BMI** = body mass index; **PEDQ-CV** = Perceived Ethnic Discrimination Questionnaire-Community Version.

INTRODUCTION

Racial disparities in cardiovascular disease (CVD) are a matter of serious national concern (1). In the United States, Blacks have significantly greater cardiovascular morbidity and mortality, and, in particular, higher rates of hypertension (HTN) compared with Whites (2). Racism has been identified as a psychosocial stressor that may contribute to the elevated rates of HTN among Black Americans (2–5).

Racism has been defined as "the beliefs, attitudes, institutional arrangements, and acts that tend to denigrate individuals or groups because of phenotypic characteristics or ethnic group affiliation" (5). An alternative term ethnic discrimination has been defined as unfair treatment because of one's ethnicity, where "ethnicity" refers to various groupings of individuals based on race or culture of origin (6,7).[1] We are particularly concerned with the cardiovascular correlates of interpersonal racism, as our work and that of others have demonstrated that interpersonal conflict is associated with increases in cardiovascular reactivity, which may confer an increased risk for CVD (3,8,9). Interpersonal racism includes directly perceived experiences of ethnicity-related maltreatment occurring in the context of social transactions. Interpersonal racism encompasses varied experiences including (but not limited to) social exclusion, workplace discrimination, physical threat, and aggression (7,10).

Racism and Blood Pressure

Despite the strong theoretical rationale for a relationship between perceived racism and HTN, there has been surprisingly little empirical research examining the relationship (see reviews in Refs. 3,11,12). Data on the relationship of perceived racism to clinic or resting BP is mixed (13–20). The evidence linking perceived racism to laboratory stress is more consistent. Perceived racism seems to be related to BP increases to both racist and nonracist laboratory stressors (3,4,11,21–27).

Recently, researchers have examined the relationship of racism to ambulatory blood pressure (ABP). ABP monitoring is useful because it permits evaluation of BP responses under "real world" conditions, allowing investigators to examine BP reactivity in the natural environment. ABP has been more closely associated with cardiovascular morbidity and mortality than clinic BP (28,29). ABP monitoring can provide measures of both waking and nocturnal BP. Nocturnal ABP and nocturnal BP dipping (i.e., decreases in BP from waking to nocturnal hours) are closely related to cardiovascular morbidity and mortality, and may be more closely linked than daytime ABP to CV outcomes (28,30,31).

To date, there have been two published studies of the relationship of racial discrimination to ABP (32,33). One study included Black adolescents and did not find a relationship of perceived racial discrimination to waking ABP (24-hour BP was assessed but only waking data were reported (32)). The other study included an adult sample of Blacks (n = 69), and reported a positive relationship of perceived racism to average daytime systolic blood pressure (SBP), but not average nocturnal BP (33).

[1]There is a little consensus on the best terms to use to distinguish among groups based on phenotypic or cultural characteristics, and both scientific and political factors influence the debate. Some groups (i.e., Blacks) have been considered "racial" groups despite the lack of biological evidence for distinct races; whereas others (i.e., Latinos) are considered ethnic groups, but have also had their ethnicity referred to as a "race". In this article, we have chosen to use the terms "race" and "ethnicity" and "racism" and "ethnic discrimination" interchangeably.

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Nocturnal Blood Pressure

Although the one study that explicitly examined nocturnal BP did not reveal a link between racism and nocturnal BP (33), other research highlights the importance of examining the relationship of psychosocial stressors to nocturnal ABP. Blacks living in the United States are less likely than Whites to display nocturnal BP dipping (34). One study suggests that among American Blacks, racial differences in dipping are likely to be related to psychosocial factors, because patterns of dipping in Black adults living in Africa are similar to those seen in White adults living in the United States (35).

There is growing evidence that nocturnal BP levels and nocturnal blood pressure dipping are associated with exposure to psychosocial stress, both from environmental factors and as a consequence of individual characteristics (33,36–40). Thus, on an environmental level, neighborhood violence has been associated with nocturnal SBP (36). On an individual level, anger-related traits have been specifically associated with nocturnal BP level and reduced BP dipping (33,37,40). In light of this evidence, we suggest that racism may serve as a psychosocial stressor that contributes to elevated nocturnal BP.

Overview of the Present Study

The goal of the present article was to investigate the relationship of perceived racism to both waking and nocturnal ABP in a sample of American-born Blacks and Latinos. We addressed several methodological issues that have been raised in the literature (3,41). Specifically, we have examined the differential effects of various dimensions of interpersonal racism by using the Perceived Ethnic Discrimination Questionnaire-Community Version (PEDQ-CV, (42)). The PEDQ-CV has four subscales that permit comparisons among the effects of social exclusion, workplace discrimination, stigmatization, and physical threat. We conducted secondary analyses controlling for personality traits, specifically cynicism and hostile attributions, which have been associated with daytime ABP and which may influence the perceptions of interpersonal interactions (43). Additional secondary analyses controlled for individual and neighborhood socioeconomic status (SES). This allowed us to distinguish effects associated with racism versus SES, because racism has been associated with SES (44,45), and in turn, SES has been associated with BP and HTN (46).

METHODS

Overview

Participants were recruited and tested at primary care practices affiliated with Clinical Directors Network, a nonprofit network of primary care clinicians in community and migrant health centers, and through word of mouth from enrolled participants, or from local advertising. Participants were tested over the course of three visits that occurred between October 2003 and August 2005. Measures of perceived racism, SES, and other demographic factors were obtained at Visit 1. Approximately 2 weeks later, during Visit 2, participants were outfitted with the ABP monitor and completed measures of hostility. They returned for Visit 3 the next day and received feedback about their ABP. Additional measures not included in these analyses were administered during Visits 2 and 3.

Participants

Participants included 357 American-born English-speaking adults between the ages of 24 and 65 (mean age = 40.08 years (SD = 9.70) of whom 217 were Black (125 women and 75 men) and 140 were Latino(a) (75 women and 65 men). Among the Latino(a) participants, 121 identified themselves as being of Puerto Rican descent, with eight of these participants also indicating that they were of mixed heritage. Participants were told that they could remove the ABP monitor if they were unable to sleep comfortably. Consequently, 245 participants had ABP data from both waking and nocturnal periods. The sample with nocturnal data comprised 151 Black (89 women, 62 men) and 94 Latino(a) (50 women, 44 men).

Participants were normotensive or unmedicated hypertensives. Exclusion criteria included current use of mediation that might affect BP, major medical conditions that would affect ABP monitoring or diary compliance, or arm circumference greater than 44 cm as American Heart Association (AHA) guidelines indicate these individuals are unlikely to be able to use a large adult cuff (47).

If the participant was diabetic or if Visit 1 resting SBP was greater than 160 mm Hg or Visit 1 diastolic blood pressure (DBP) was greater than 100 mm Hg, the participant was required to obtain physician permission to participate to insure that they were under a doctor's care. A total of 18 participants (5%) were diabetic. Mean body mass index (BMI) for the sample was 28.46 (SD = 5.48; range, 18–48). Twenty-seven percent (n = 96) of the sample had a BMI in the normal weight range, 41% (n = 146) in the overweight range, 20% (n = 72) in the obese Category I range, 8% (n = 28%) in the obese Category II range, and 4% (n = 15) in the obese Category III range.

In the full sample, 25% (n = 90) had less than a high school education, 60% (n = 213) had a high school diploma, and 15% (n = 54) had a college degree. Half the sample (49%) was employed, and participants worked in occupations ranging from food service worker to physician. This was a relatively poor sample with a median gross household income of $18,100, and 78% of the sample reported a gross household income less than three times the poverty level. Most (68%, n = 243) were single, separated, divorced or widowed, and 32% were married or living with someone.

All participants were given a total of $165 in compensation for participation. The Institutional Review Boards of St. John's University, CDN, Jamaica Hospital Medical Center, and the City University of New York approved the protocol.

Measures

Although all participants were English-speaking, all items on the questionnaires and diaries were presented in both English and Spanish. All materials were translated and back-translated by American Translator's Association accredited translation firms, and the materials were additionally reviewed by lay readers from Colombia, Dominican Republic, Puerto Rico, and Spain to insure appropriateness.

Demographics

A brief demographics interview was administered to obtain information on race, ethnicity, gender, age, marital status, household composition, housing status, place of birth, years in the United States, and parents' place of birth.

Perceived Racism

Perceived racism was assessed with the PEDQ-CV (42). The PEDQ-CV assesses lifetime experiences of ethnic discrimination within a social or interpersonal context (42). The measure is a modification of the PEDQ-Revised B, developed by Contrada et al. (7). The measure contains a 34-item lifetime exposure to an ethnic discrimination scale in which each item begins with the phrase "Because of your ethnicity/race... . " and ends with a description of a specific event or interaction. Items are rated on a scale from 1 to 5 with 1 = never and 5 = very often.

The lifetime scale includes four subscales including social exclusion, workplace discrimination, stigmatization, and threat and harassment. A series of studies have provided evidence of construct validity (42). The scale and subscales have good internal consistency in this sample (Cronbach's alpha for

the full scale was 0.95, and the Cronbach's alphas for the subscales range from 0.74 to 0.87).

Socioeconomic Status

We used a degree-based measure of education in which individuals were classified as belonging to one of three categories: less than high school education, high school degree or general equivalency diploma, and college or graduate degree. Employment status was assessed by asking if the participant was currently working, either full or part time, or not working. Gross household income (GHI) reflected all income from wages, self-employment, interest, social security disability or supplemental income, retirement income or alimony, investments for the individual and his or her spouse, and any other income-producing household member.

A composite measure of neighborhood SES measures was derived from 2000 census data using block-group level information. The composite measure comprised the sum of the standardized (to the sample) scores for median family income, median home values, percentage of White collar occupations, and percentage of college graduates.

Diary Data

The electronic diary was administered using a SONY CLIE PDA with the Quest Admin Program, which automatically time- and date-stamped each entry. Only those entries occurring within 5 minutes of the BP reading were included in the analyses. The diary inquired about location, posture, caffeine use, alcohol use, and smoking as well as social interactions and mood. Participants were trained in the use of the diary and practiced competing diary pages at the time they were outfitted with the ambulatory monitor. Picture icons and accompanying words were used to present the items.

Cynicism and Hostility

Hostile attributions and cynicism were measured with the Hostile Attribution and Cynicism subscales of the MMPI-based Cook and Medley Hostility scale (Ho) that were developed by Barefoot et al. (48). The hostile attribution subscale reflects a tendency to interpret the behavior of others as intended to harm the respondent as reflected in suspicion, paranoia, and fear of threat to the self. Cynicism represents a general negative view of the world and of people as being unworthy, deceitful, and selfish. Barefoot et al. (48) demonstrated the convergent and discriminant validity of these subsets. Participants responded to the measure on a six-point scale indicating the extent to which they agreed with each item. The alpha coefficient for this sample for the combined hostility measure was 0.75.

Ambulatory Blood Pressure

As in our prior research (8,43,49), measures of SBP, DBP, and HR were collected throughout the workday using the Suntech Accutracker II (Suntech Medical Instruments, Raleigh, NC), an instrument with documented reliability and validity (50).

When participants were outfitted with the BP monitor a series of eight sittings and standing baseline readings were obtained. BP was taken automatically every 20 minutes from morning to bedtime and every hour after bedtime (i.e., the time participants reported they were likely to go to sleep). Participants completed an electronic diary at the time of every waking reading. Participants were provided with instructions on methods for terminating or initiating a BP reading. A research staff member was available by cell phone 24 hours a day. When participants returned for Visit 3, they provided information about their actual bedtime, and BP readings were assigned to nocturnal versus waking hours based on these reports.

Analytic Plan

Initial analyses examine the relationship of gender, race, and age to waking and nocturnal ABP and perceived racism to determine whether they should be used as covariates in subsequent analyses. For the initial analyses and tests of the main hypotheses of the study, we used mixed models regression analyses estimated using PROC Mixed, developed by the SAS Institute (51). In comparison with standard repeated measures or regression analyses, these mixed models offer a more efficient and potentially more powerful strategy for significance testing when using EMA (52,53). Analyses were performed using three variance structures: compound symmetry alone, autoregression alone, and compound symmetry plus serial autocorrelation, using the sp(pow) procedure from SAS. The combined error structure provided the best fit. Unstandardized parameter estimates are reported.

Predictor variables include lifetime perceived racism (PEDQ-CV total), time period (waking hours/nocturnal hours), and their interaction. Time period was treated as a random effect. Analyses were performed separately for ambulatory SBP and DBP. Between-person covariates in the initial analyses include age, gender, race, and BMI. Posture is the only within-person covariate included in these analyses. Follow-up analyses examine the relationship of racism to ABP separately for each time period. Additional analyses are conducted to determine the type of racism most closely associated with ABP. When follow-up analyses were performed on waking BP, additional covariates including caffeine and alcohol use, smoking, and talking were included in the analyses.

In subsequent analyses the effects of additional between-person variables (i.e., hostility and SES) that may account for any relationship of racism to ABP were examined. First, the relationship of hostility and SES to ABP was examined. Next, primary analyses were conducted with these variables included as additional covariates.

Finally, logistic regression analyses were performed to evaluate the relationship of perceived racism to nocturnal blood pressure dipping status (i.e., to a decrease of greater than 10% in blood pressure from waking to nocturnal hours).

Detection of Artifactual Measurements

Procedures for detection and deletion of potentially artifactual readings were identical to those used in our prior studies (8,43,49). If the difference between SBP and DBP was <20 or exceeded 90 mm Hg, then SBP, DBP, and HR readings were deleted from the analysis. If ABP readings were accompanied by error codes indicating a problem with the equipment (i.e., ECG leads, cuff, or cables) then SBP, DBP, and HR readings were also deleted. Once these categories of error readings were deleted, BP readings were included in the following ranges: SBP was greater than 85 and less than 196, DBP was greater than 41 but less than 130, and HR values were greater than 46 and less than 195. If either SBP or DBP was considered to be erroneous, then both BP readings were removed from subsequent analyses (54).

Sampling Interval and Mean Number of ABP Measurements

During waking hours BP measurements were made every 20 minutes; during nocturnal hours (with sleep time defined by the participant) the BP measurements were made every hour. We obtained an average of 28.64 (SD = 10.31; range, 1–58) postbaseline readings when individuals were awake and an average of 4.66 (SD = 2.71; range, 1–15) readings during the nocturnal period when individuals indicated that they were asleep. During the waking hours the average individual mean for SBP was 132.79 mm Hg (SD = 15.20) and for DBP was 80.15 mm Hg (SD = 10.23). During the nocturnal period, average individual mean SBP was 124.56 (SD = 20.30) and DBP was 72.22 (SD = 14.14).

RESULTS

We examined hypertensive status using the resting baseline readings obtained at the start of the testing day on the full sample. In the current sample of unmedicated individuals, 80 (22%) individuals were classified as hypertensive using criteria set forth by the Seventh Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (i.e., SBP $\geq$ 140 or DBP $\geq$ 90 (55)), with 61 classified as having BP levels in the Stage 1 range and 19 having BP levels in the Stage II range. In addition, 147 (41%) had BP in the pre-hypertensive range, 128 (36%) had BP in the normal range, and two did not have usable baseline BP readings.

TABLE 1. Sociodemographic Variations in Waking and Nocturnal ABP in Millimeters of Mercury (mm Hg)

Sociodemographic Variables	Waking SBP $N = 357$	Nocturnal SBP $N = 245$	Waking DBP	Nocturnal DBP
Gender				
Women	129.09 (1.09)*	122.73 (1.72)*	78.27 (0.74)	71.18 (1.15)
Men	137.47 (1.23)	126.75 (1.95)	82.70 (0.84)	73.04 (1.30)
Race/ethnicity				
Black	133.88 (1.07)	125.46 (1.65)	81.48 (0.71)**	73.78 (1.09)**
Latino	130.97 (1.37)	122.97 (2.08)	78.16 (0.91)	69.18 (1.37)
Education level				
<HS	135.91 (1.62)	125.52 (2.55)	81.45 (1.08)	72.62 (1.62)
HS	132.28 (1.08)	125.01 (1.74)	80.14 (0.72)	71.89 (1.11)
College+	130.25 (2.08)	120.77 (3.18)	77.71 (1.39)	68.96 (2.03)
Employment				
Not working	134.71 (1.19)***	127.26 (1.84)***	81.58 (0.79)***	73.20 (1.17)
Working	131.32 (1.16)	121.58 (1.89)	78.79 (0.77)	69.98 (1.20)
Poverty group				
≤1× poverty level	135.07 (1.30)	126.58 (2.04)	81.42 (0.87)	73.15 (1.30)
≤2× poverty level	131.29 (1.61)	124.19 (2.56)	80.14 (1.08)	72.25 (1.63)
≤3× poverty level	133.31 (2.26)	122.00 (3.72)	79.85 (1.52)	69.97 (2.37)
>3× poverty level	130.80 (1.66)	122.57(2.66)	78.08 (1.11)	69.25 (1.70)

Analyses of the effects of education, employment status, and poverty group include BMI, age, gender and race as covariates. The means reported are adjusted for these covariates, with the standard error reported in parentheses.

* Men versus women, $p < .05$.

** Blacks versus Latino(a)s, $p < .01$.

*** Employed versus unemployed, $p < .05$.

Comparisons Between Those With and Without Sleep Data

A larger sample ($n = 357$) was available for analyses of the effects of racism on daytime ABP than that was available for analyses of the effects of racism on nocturnal ABP ($n = 245$). There were no significant differences in hypertensive status between those who did and did not have nocturnal BP data (χ^2 (3) = 3.89, $p > .27$). There were no significant differences between those who did versus did not have nocturnal data on race, gender, age, marital status, education, or employment status (all p values ns). Those with sleep data tended to have slightly higher incomes ($p < .07$). Those with sleep data had significantly lower BMI (mean = 28.00) than those without sleep data (mean BMI = 29.41; $F(1,355) = 5.60$, $p < .02$).

Demographic Variations in ABP

These analyses examine sociodemographic differences in perceived racism and in waking and nocturnal ABP to determine which variables should be considered as covariates in the main analyses. ANOVAs revealed that there were no main effects of gender, education, occupational status, or income level differences in PEDQ-CV total scores. There were marginal race/ethnicity differences, with Blacks reporting slightly higher levels of exposure than Latino(as) ($F(1,355) = 3.61$, $p < .08$).[2]

Table 1 displays sociodemographic differences in mean waking and nocturnal ABP. Mixed models analyses with gender as the independent variable indicated that in comparison with women, men had significantly higher waking SBP ($F(1,332) = 26.17$, $p < .0001$) and waking DBP ($F(1,332) = 15.71$, $p < .0001$), but did not differ in nocturnal SBP ($p < .13$) or DBP ($p < .29$). Race/ethnicity analyses revealed that in comparison with Latino(a)s, Blacks had significantly higher levels of waking DBP ($F(1,332) = 8.27$, $p < .01$), marginally higher levels of waking SBP ($F(1,332) = 2.81$, $p < .10$), and significantly higher nocturnal DBP ($F(1,242) = 6.89$, $p < .01$). As expected, age was positively associated with waking SBP ($B = 0.25$, $SE = 0.09$, $t = 2.95$, $p < .005$), nocturnal SBP ($B = 0.42$, $SE = 0.15$, $t = 2.71$, $p < .01$), waking DBP ($B = 0.25$, $SE = 0.06$, $t = 4.49$, $p < .0001$), and nocturnal DBP ($B = 0.46$, $SE = 0.08$, $t = 5.58$, $p < .001$). Consequently, age, gender, and race/ethnicity were entered as covariates in subsequent analyses.

Racism and ABP

To evaluate the association of perceived racism to ABP, mixed models analyses were performed with perceived racism (PEDQ-Total), time period (waking versus nocturnal), and their interaction serving as predictor variables. Gender, race/ethnicity, age, and BMI served as between-person covariates. Posture served as a within-person covariate. For SBP, the main effect of perceived racism approached significance ($F(1,341) = 2.72$, $p < .10$), but both the main effect of time period ($F(1,230) = 16.10$, $p < .001$) and the interaction of perceived racism by time period ($F(1,7449) = 11.08$, $p < .001$) were highly significant. For DBP, the effect of perceived racism was not significant ($F(1,341) = 1.37$, $p < .24$), but the main effect of time period ($F(1,230) = 7.83$, $p < .01$), and the interaction of perceived racism by time period (F (1,7449) =

[2]Previously, we have reported that sociodemographic differences in perceived racism depend on the dimension (subscale) of racism under investigation (56).

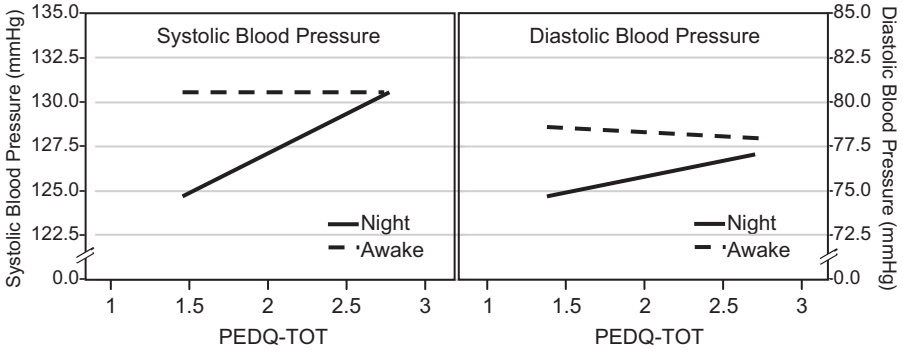

Figure 1. Predicted waking and nocturnal BP as a function of perceived racism (PEDQ-CV lifetime discrimination), adjusted for age, gender, race/ethnicity, body mass index, hostility, and individual SES.

4.41, $p < .04$) were significant. Figure 1 displays predicted scores of the interaction of perceived racism and time period for SBP and DBP, displaying estimated effects of perceived racism on waking and nocturnal ABP. The figures suggest that there is a positive relationship of racism to nocturnal ABP, but not to waking ABP.

Follow-up analyses of the significant interaction effects were conducted to examine the association of perceived racism to ambulatory SBP and DBP separately for waking and nocturnal periods. The results indicate a significant association of perceived racism to nocturnal, but not to waking SBP and DBP. Specifically, the association of perceived racism to waking ambulatory SBP and DBP was not significant ($t < 1$, p values = ns). However, the association of perceived racism to nocturnal SBP ($B = 5.22$, $SE = 1.97$, $df = 238$, $t = 2.64$, $p < .01$) was significant and the association of perceived racism to nocturnal DBP ($B = 2.40$, $SE = 1.26$, $df = 238$, $t = 1.90$, $p < .06$) approached significance.[3]

Both diabetes and morbid obesity have been associated with nocturnal BP (57,58). Therefore, all analyses were controlled for BMI, and we repeated the analyses eliminating individuals with diabetes. The effects of perceived racism on nocturnal ABP remained significant for both SBP and DBP when diabetics ($n = 18$) were removed from the sample.[4]

Subscale Analyses

The primary analyses were repeated with the four subscales of the PEDQ-CV entered instead of the lifetime score to determine if any subscale was uniquely related to ABP, controlling for the effects of the others. For nocturnal DBP, stigmatization was the only scale to emerge as independently associated ($B = 2.63$, $SE = 1.33$, $df = 235$, $t = 1.98$, $p < .04$). For nocturnal SBP, no single scale emerged as a significant predictor controlling for the effects of the other scales.

Effects of Trait Hostility on Perceived Racism

Hostility was positively associated with perceived racism ($r = 0.23$, $p < .001$), and was weakly associated with waking DBP ($p < .10$) but was unrelated to nocturnal BP. With hostility included as an additional covariate the interaction of perceived racism by time period was significant for both SBP ($p < .001$) and DBP ($p < .05$), and the associations of racism to nocturnal SBP ($p < .01$) and DBP ($p < .05$) also remained significant.

Effects of Socioeconomic Status on Perceived Racism

Table 1 displays mean ABP (adjusted for race, gender, and age) for education level and employment status. Poverty ratios were calculated by dividing the participant's gross household income by the poverty level income for households with equivalent numbers of members, seniors citizens, and children (18 and below). A poverty ratio of one indicates that the gross household income is equivalent to the poverty level for a household of similar composition. Participants were divided into income level groups based on the ratio of their gross household income to the poverty level income for households with equivalent numbers of members, senior citizens, and children (18 and below). Four income level groups were constructed: a) Group 1 (≤ poverty level), income at or below poverty level for households of their size and composition; b) Group 2 (≤2× poverty level), income more than the poverty level, but less than twice the poverty level; c) Group 3 (≤3× poverty level), income more than twice the poverty level, but less than three times the poverty level; and d) Group 4 (>3× poverty level), income more than three times the poverty level.

Mixed models analyses controlling for BMI, age, gender, and race revealed marginal effects of education on waking SBP ($p < .08$) and DBP ($p < .11$), and nonsignificant associations with nocturnal BP (p values < 0.30). Employment (versus unemployment) was associated with lower levels of waking SBP ($F(1,329) = 4.19$, $p < .05$), DBP ($F(1,329) = 6.39$, $p < .02$) and nocturnal SBP ($F(1,239) = 4.51$, $p < .04$), and marginally associated with nocturnal DBP ($F(1,239) =$

[3]In the primary analyses all 357 participants are included. However, the main effect and interaction effects are equivalent if the analyses are confined to the 245 individuals who have both waking and nocturnal readings. The effects of perceived racism on waking BP remain nonsignificant when analyses are confined to the subset with sleep readings. The effects of perceived racism on nocturnal SBP remain significant and the effects of perceived racism on DBP achieve significance ($p < .03$) when analyses are confined to the subset of participants with 3 or more nocturnal readings.

[4]In addition, the effects remain significant for SBP and marginally significant for DBP ($p < .13$) when individuals with Stage II or III obesity (i.e., BMI > 35, $n = 42$) were removed from sample.

3.57, $p < .06$). There were no significant relations of poverty group to waking or nocturnal SBP or DBP.

We repeated the primary analyses with the three measures of individual SES and hostility included in the analyses. The interaction of PEDQ and Time Period remained significant for both SBP ($p < .001$) and DBP ($p < .05$). Follow-up analyses performed by time period and with these additional covariates indicated that the effects of perceived racism on nocturnal SBP ($B = 5.16$, $SE = 2.04$, $df = 234$, $t = 2.52$, $p < .02$) remained significant and the effects on DBP approached significance ($B = 2.34$, $SE = 1.31$, $df = 234$, $t = 1.79$, $p < .08$). The effects are significant for both SBP and DBP when the analyses are confined to the 183 individuals with three or more nocturnal readings. Marital status is associated with SES, but the effects of racism on nocturnal BP also remained significant when marital status was included as an additional covariate.

Blood Pressure Dipping

Conventionally, physicians use nocturnal dipping status (i.e., a change from waking to nocturnal BP of 10% or greater) as an index of cardiovascular risk (59). To assess the relationship of perceived racism to nocturnal dipping, we conducted a logistic regression analysis with age, race/ethnicity, gender, and BMI serving as covariates, perceived racism serving as a predictor and dipping status (yes or no) serving as the outcome. The effects of perceived racism were significant (estimate = 0.53, SE = 0.26, $p < .05$). The odds ratio associated with each standard deviation increase in perceived racism was 1.40 (95% CI, 1.01–1.93), suggesting that for each 1 SD increase in PEDQ score, the odds of being a nondipper increased by 40%. When we included only those individuals with three or more nocturnal readings ($n = 183$), the odds ratio increases to 1.70 (95% CI, 1.02–2.84). The effects remain significant and the odds ratio does not change when sociodemographic and personality covariates are included.

DISCUSSION

The aim of the present study was to test the hypothesis that perceived racism was associated with ABP in a sample of community-dwelling adults. Results indicated that perceived racism was associated with nocturnal SBP and nocturnal DBP, but not with daytime ABP. Additionally, perceived racism substantially increases the risk of failing to display the expected pattern of nocturnal blood pressure dipping.

The findings further suggest that the relationship of racism to nocturnal ABP is not a function of trait hostility, specifically the tendency to attribute hostile intent to others or to view the world in a cynical manner. In addition, employment status and poverty ratio were associated with ABP in this sample. However, the effects of racism on nocturnal ABP persisted despite controlling for these variables and for education level. This suggests that racism is a unique psychosocial stressor, exerting effects on cardiovascular system above and beyond traditional stressors such as low SES and hostility.

These results are partly consistent with those of Steffen et al. (33) who reported an association of perceived racism to daytime but not nocturnal ABP. It is possible that we did not find an association between racism and daytime ABP (even in the larger sample with available daytime readings), because our sample included both employed and unemployed individuals whose activities and life demands may be more diverse than those of the individuals included in the sample of employed individuals included in the study by Steffen et al. (33). Activities during the day may have been too varied, both in emotional and physical demands, to easily evaluate the effects of a single individual difference variable (i.e., racism) on daytime cardiovascular response. Gerin et al. (60) have found, for example, that a distraction tends to attenuate angry thoughts, as well as BP elevation, in the laboratory; and the natural environment comprises many distractions that may curtail rumination. Regional or sample-specific variations in the association of racism to daily stress or coping may also account for differences in the findings.

As investigators have suggested, the association of perceived racism to BP may depend in part on the link between exposure to maltreatment and the strategies for coping with maltreatment (19). For example, in the same sample in which racism was associated with day-time ABP, Steffen et al. (33) reported that anger suppression is associated with nocturnal ABP. In prior studies, we have shown that perceived racism was positively related to both experiences of anger and anger suppression (10,41). Future analyses will examine the role of anger and anger suppression on the relationship of racism to ABP.

In contrast, the effects of racism may be more discernible at night without the events of the day available to distract the individual. As we have demonstrated previously, perceived racism seems to be positively associated with the intensity of daily negative social interactions and daily negative mood, as well as threat appraisals (41). These daily stressors and distress responses may be associated with more difficulty in reducing psychophysiological activation at night. Individuals may remain in a persistent state of distress, even if they do not attribute the cause of their distress to racism, or they may ruminate about specific episodes of unfair treatment. Both distress and rumination may disrupt sleep or contribute to heightened arousal during sleep (61,62).

LIMITATIONS

The nocturnal BP data do not represent a true measure of sleep BP, because we did not obtain measures of movement or polysomnography. Instead, we used the participant's self-report of the time they went to sleep. It is possible that perceived racism is actually associated with sleep quality and that the higher BP levels observed in those with high levels of racism reflect sleep difficulties (i.e., the participant is lying down and resting but unable to sleep during these periods (63)). New research suggests that American Blacks report difficulties with sleep and that perceived racism is associated with sleep quality (63,64). Further research with controls for

subjective and objective indices of sleep quality will be necessary to determine if the effects of racism on nocturnal BP are a function of sleep difficulties or of stress-related effects on autonomic control during sleep.

Both diabetes and morbid obesity are associated with elevated nocturnal BP. However, in addition to controlling for these variables, we also reanalyzed the data with individuals who were diabetic or morbidly obese removed from the sample. The effects of racism on nocturnal BP remained significant with these individuals eliminated from the analyses.

Only 69% of the sample completed the nocturnal monitoring. These individuals had lower BMI scores than those who did not complete the sleep study, but did not differ from those who did not complete nocturnal monitoring on reports of racism, personality measures, or SES. Finally, the current sample is under-powered to appropriately test race/ethnicity differences in the association between racism and BP. Future analyses will examine ethnicity effects.

SUMMARY AND CONCLUSIONS

Overall, the data support the hypothesis that perceived racism is associated with nocturnal BP and an increased risk of nondipping in a population of community-dwelling urban Black and Hispanic adults. Further, the findings indicate that the observed effects are not a function of poverty or of a general tendency to view the world as unfair or threatening. Given the link between nocturnal BP and cardiovascular morbidity, these results suggest a mechanism that may potentially explain racial disparities in HTN.

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