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Lifetime racial/ethnic discrimination and ambulatory blood pressure: The moderating effect of age

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Abstract

Objective—To determine if the relationships of lifetime discrimination to ambulatory blood pressure (ABP) varied as a function of age in a sample of Black and Latino(a) adults ages 19 – 65.

Methods—Participants were 607 Black ($n = 318$) and Latino(a) ($n = 289$) adults (49% female) who completed the Perceived Ethnic Discrimination Questionnaire-Community Version (PEDQ-CV), which assesses lifetime exposure to racism/ethnic discrimination. They were outfitted with an ABP monitor to assess systolic and diastolic blood pressure (SBP, DBP) across a 24-hour period. Mixed-level modeling was conducted to examine potential interactive effects of lifetime discrimination and age to 24-hour, daytime, and nighttime ABP after adjustment for demographic, socioeconomic, personality and life stress characteristics, and substance consumption covariates (e.g., smoking, alcohol).

Results—There were significant interactions of Age \times Lifetime Discrimination on 24-hour and daytime DBP ($ps = .04$), and in particular significant interactions for the Social Exclusion component of Lifetime Discrimination. Post-hoc probing of the interactions revealed the effects of Lifetime Discrimination on DBP were seen for older, but not younger participants. Lifetime discrimination was significantly positively associated with nocturnal SBP, and these effects were not moderated by age. All associations of Lifetime Discrimination to ABP remained significant controlling for recent exposure to discrimination as well as all other covariates.

Conclusions—Exposure to racial/ethnic discrimination across the life course is associated with elevated ABP in middle to older aged Black and Latino(a) adults. Further research is needed to understand the mechanisms linking discrimination to ABP over the life course.

Keywords

Discrimination; Disparities; Hypertension; Age; African Americans

Hypertension (HTN), a major risk factor for cardiovascular disease (CVD), affects about one in three U.S. adults. Striking racial disparities in HTN abound. Compared with Whites, Blacks experience an earlier onset of HTN, have higher average blood pressure, and experience more secondary illnesses as a result of HTN (American Heart Association, 2005). Although Latino(a)s have similar rates of HTN as Whites, they are less likely to be diagnosed and have poorer blood pressure control (Centers for Disease Control and Prevention, 2012). It is therefore critical to understand predictors of HTN and elevated blood pressure in these two racial/ethnic minority groups.

Several systematic reviews document the key role of racism in health outcomes among racial/ethnic minorities (Mays, Cochran, & Barnes, 2007; Paradies, 2006; Pascoe & Smart-Richman, 2009; Williams & Mohammed, 2009). Racism is defined as “the beliefs, attitudes, institutional arrangements, and acts that tend to denigrate individuals or groups because of phenotypic characteristics or ethnic group affiliation” (Clark, Anderson, Clark, & Williams, 1999). Racism often unfolds in one-on-one interpersonal interactions and is perpetrated by individuals across a myriad of social roles. In the current study, we will use the terms racial/ethnic discrimination and discrimination interchangeably to refer to maltreatment unfolding at the individual level and attributed to racial or ethnic bias.

Both African Americans and Latino(a)s report experiencing discrimination. African Americans report the highest rates of major lifetime discrimination (48.9%) (Kessler, Mickelson, & Williams, 1999), with 91.2% experiencing minor day-to-day discrimination. With regard to U.S. born Latino(a)s, almost half (47%; Perez, Fortuna, & Algeria, 2009) report minor day-to-day experiences of discrimination. Substantially fewer Whites experience racism – 30.9% and 24% report major lifetime and minor day-to-day discrimination, respectively (Kessler et al., 1999). It is therefore no surprise that racism has been posited to act as a chronic, unremitting stressor in the lives of racial/ethnic minorities (Brondolo et al., 2005; Clark et al., 1999).

Three reviews have examined studies linking racism and HTN risk as assessed by clinic or resting blood pressure, blood pressure reactivity, and ambulatory blood pressure (ABP; Brondolo, Rieppi, Kelly, & Gerin, 2003; Brondolo, Love, Pencille, Schoenthaler, & Ogedegbe, 2011; Dolezsar, McGrath, Herzig, & Miller, 2014). The consistency of the relationship of racism to ABP, and in particular nocturnal ABP was noted in each review. ABP measurement captures fluctuations in blood pressure (BP) across one's normal daily life and is a strong prognostic indicator of future CVD morbidity and mortality (Ohkubo et al., 2002). In addition, a day-to-night decline (“nocturnal dipping”) in BP of < 10% has been used to characterize non-dipping status (i.e., a lack of expected nighttime decline in BP), a status that is associated with an increased risk for CVD (Sherwood, Steffen, Blumenthal, Kuhn, & Hinderliter, 2002). Nighttime ABP and BP dipping are stronger predictors of target organ damage compared with office BP, and studies have suggested that Black individuals are substantially less likely to demonstrate dipping (Munter et al., 2014). All eight studies of the relationship of discrimination (or the related variable of unfair treatment) to ABP reviewed reported significant relations of greater discrimination to either higher daytime ABP, nighttime ABP, and/or lower blood pressure dipping (Beatty & Matthews, 2009; Brondolo et al., 2008; Hill, Kobayashi, & Hughes, 2007; Matthews, Salomon, Kenyon, &

Zhou, 2005; Richman Smart, Pek, Pascoe, & Bauer, 2010; Singleton, Robertson, Robinson, Austin, & Edochie, 2008; Steffen, McNeilly, Anderson, & Sherwood, 2003; Tomfohr, Cooper, Mills, Nelesen, & Dimsdale, 2010).

Gee, Walseman, and Brondolo (2012) conceptualize racism and racial/ethnic discrimination as a life course phenomenon. Specifically, they suggest that within individuals, exposure to discrimination can change in form and frequency across the life course. Given the historical changes in the experience and expression of racial/ethnic discrimination in the U.S., there may also be important differences among age cohorts. Gee et al. (2012) point out that it critical to examine exposure to discrimination across the life course and within a historical context in relation to health outcomes. Therefore, the aim of the present study is to examine the degree to which age moderates the link between racial/ethnic discrimination across the life course and ABP.

We posit that there are at least three major reasons to examine the effects of age on the relation of lifetime discrimination to ABP. First, there may be cohort effects in exposure to amount and types of discrimination (e.g., overt/blatant vs. covert; Gaertner & Dovidio, 2009). Second, there may be an age difference in cumulative exposure. Third, as individuals age they can develop vulnerabilities within the cardiovascular system including an increase in arterial stiffening (Franklin et al., 1997; Landahl, Bengtsson, Sigurdsson, Svanborg, & Svärdsudd, 1986; Lee & Oh, 2010; Pinto, 2007), decreased baroreceptor sensitivity, and increased reactivity to sympathetic nervous system stimuli (Pinto, 2007). Altogether, the cumulative wear and tear of chronic discrimination coupled with an aging cardiovascular system may place older racial/ethnic minorities at greater risk for HTN.

The present study used data from the Racism, Coping, and 24-hour Ambulatory Blood Pressure study, which is based on a sample of African American and Latino(a) adults residing throughout the New York City metropolitan area. We examined whether age moderated the relation of lifetime exposure to perceived racism on ABP over a 24-hour period after adjusting for key potential confounders including socioeconomic status, cynicism, life stress, body mass index (BMI); and consumption of substances known to have effects on blood pressure including caffeine, alcohol, and smoking. We posited that the association of lifetime discrimination to ABP would be stronger in older as compared to younger adults. We further explored whether these associations were more pronounced for African Americans than Latino(a)s, and whether the effects were a function of lifetime exposure to discrimination versus more recent exposure.

METHODS

Participants

Participants were drawn from the Racism, Coping, and 24-hour Ambulatory Blood Pressure study conducted from 2003 through 2007. Participants were recruited using word of mouth, local advertising, and primary care practices affiliated with Clinical Directors Network (CDN), a practice-based research network. Volunteers for the study included 801 individuals¹, including Black (50.2%) and Latino(a) adults of any race ($M = 39.11$, $SD = 9.53$, range 19 – 65).

A total of 670 individuals were eligible for the current analyses, and the final analytic sample was comprised of the 607 participants who had daytime ABP data, electronic diary records, and scores on measures of lifetime discrimination, and demographic variables (i.e., age, gender, race, and BMI). Participants were all English-speaking, but had the option of completing the measures in Spanish (see Brondolo, Libby et al. 2008). Demographic information about the sample is provided in Table 1. Participants were paid \$165 upon completing the three-visit study protocol. This study was approved by the Institutional Review Boards of St. John's University, CDN, Jamaica Hospital Medical Center, and the City University of New York.

During Visit 1 participants completed questionnaires, including the measure of discrimination. Three measures of seated baseline BP were taken using an OMRON HEM electronic sphygmomanometer. The average of these readings serves as office resting BP. During Visit 2, which occurred within the following two weeks, participants completed additional measures and were outfitted with the ABP monitor. Visit 3 occurred the following day, and participants received feedback about their ABP and completed additional psychosocial measures.

Measures

Demographics and Body Mass Index (BMI)—A demographic questionnaire was administered to gather data on race, ethnicity, gender, age, education, marital status, household composition and income, housing status, parents' place of birth, medication use, and other relevant descriptive factors. BMI was calculated as weight (in kilograms) divided by height (in meters squared).

Lifetime and Past Week Perceived Racism/ Ethnic Discrimination—The Full Perceived Ethnic Discrimination Questionnaire–Community Version (PEDQ-CV; Brondolo et al., 2005) was used to assess discrimination. The PEDQ-CV is a 70-item questionnaire consisting of five scales, two of which are included in the present study. This 34-item scale assesses lifetime experiences of ethnic discrimination within an interpersonal context. The Lifetime Discrimination scale yields a total score as well as scores for each of its four subscales – Threat/Harassment, Stigmatization, Social Exclusion, and Discrimination at Work. Cronbach alphas for the Lifetime Discrimination scale (.91) and each of the subscales (threat/harassment = .79, stigmatization = .83, social exclusion = .78, and discrimination at work = .76) were good. Recent exposure to discrimination was assessed with the PEDQ-CV Past Week Discrimination scale, a 10-item scale that assesses everyday experiences of threat/harassment, stigmatization, and social exclusion. The measure asks about the frequency with which these events occurred during the past week and has a Cronbach's alpha of .92.

Socioeconomic Status (SES)—Education and income served as indicators of SES. Three degree-based categories were created for education; less than high school education, high school degree or general equivalency diploma, and college degree or higher. To assess income, individuals were categorized into poverty-level groups (based on adjusted gross

household income) as gross household income was not normally distributed in this sample (for details see Brondolo, Beatty, et al., 2009).

Posture and substance consumption—Observation level data on posture and substance consumption (i.e., caffeine and alcohol use and smoking) were obtained with an electronic diary (CLIE PDA SONY, New York, NY) and administered via the Quest Admin Program, which automatically stamps each entry with the date and time. Participants completed practice entries at the time that they were outfitted with the ABP monitor. During the testing day, entries not completed within five minutes of the ABP reading during waking hours were excluded from analyses. At each reading, the diary assessed posture (coded as sitting, standing, walking, running, and lying down). During waking hours, participants recorded their use of caffeine, alcohol, or cigarettes at the time of the reading or since the last reading (within the previous 20 minutes). Since no diary data were collected once individuals went to bed, three additional substance consumption variables were created for use in analyses of 24-hour and daytime ABP. These variables reflected the proportion of diary readings accompanied by indications of caffeine use, alcohol use, or smoking.

Cynical Hostility—Cynical hostility was measured using the Cynicism and Hostile Attributions subscales of the MMPI-based Cook and Medley Hostility scale (Ho) which has demonstrated good convergent and discriminant validity (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989). In the current sample, the Cronbach's alphas for the cynical hostility subscale was .71.

Life Experiences Scale—The Life Experiences Survey (LES; Sarason, Johnson, & Siegel, 1978) is a self-report measure of major and minor life events that occurred in the past year and their positive or negative impact. The LES has good reliability and moderate test-retest reliability at five to six week intervals. For this study, we included the sum of life events the participant reported occurring over the past year.

Ambulatory Blood Pressure—Measures of systolic BP (SBP) and diastolic BP (DBP) across the 24-hour monitoring period were collected using the Suntech Accutacker II (Suntech Medical Instruments, Raleigh, NC), an instrument with documented reliability and validity (White & Morganroth, 1989) and patient acceptability. At the time participants were outfitted with the ABP monitor, four sitting and two standing baseline readings were obtained to ensure a correct fit of the blood pressure cuff and monitor and accurate readings. The mean of these readings serves as day-of-testing, baseline resting ABP readings.

ABP was taken automatically every 20 minutes from morning to the expected bedtime, which was the time participants reported they were likely to go to sleep. After the expected bedtime, nocturnal BP was taken every hour. In unison with each of the daytime readings, participants completed the electronic diary.

Analytic Plan—For descriptive analyses of relations of all key variables with age, age was treated as a categorical variable using the median split (< 39 years of age). In the inferential analyses, age was treated as a continuous variable. We examined hypertensive status based on the resting baseline BP readings obtained at Visit 1, using the standard criteria (JNC-7;

Chobanian et al., 2003). In addition, correlations and ANOVA were used to evaluate potential covariates considered for inclusion in subsequent analyses, including gender, race, BMI, education, poverty level, personality (i.e., cynical hostility), sum of life stressors, and average use of substances (i.e., caffeine, alcohol, or smoking) on the day of testing. Additional preliminary analyses examined the relationship of racism to office resting BP (assessed with clinic resting BP and day-of-testing resting ABP) and daytime and nocturnal BP. To test the hypothesis that age moderates the effects of lifetime discrimination on ABP, we examined the Age \times Lifetime Discrimination interaction, with the main effects of age and lifetime discrimination in the model. To examine the possibility that there were race or gender differences in the relation of age and discrimination to ABP, we first examined the three way interactions of Race \times Age \times Lifetime Discrimination and Gender \times Age \times Lifetime Discrimination, including all main effects and two-way interactions in each model.

Models were tested using mixed effects regression analyses estimated via PROC Mixed, developed by the SAS Institute (Littell, Milliken, Stroup, & Wolfinger, 1996). In comparison to standard repeated measures or regression analyses, mixed models offer a more efficient and powerful strategy for significance testing when using ecological momentary assessment (Schwartz & Stone, 1998). Our primary hypotheses focus on age differences in the effects of discrimination on 24-hour SBP and DBP. In additional analyses to determine if the effects of discrimination on 24-hour ABP are seen in primarily in daytime versus nocturnal BP, we computed models for daytime SBP and DBP and nocturnal SBP and DBP. Degrees of freedom were calculated using Satterwaite criteria. Logistic regression analyses were employed to test hypotheses about the interactions of Age \times Lifetime Discrimination with dipping status as the outcome. As we tested each hypothesis twice (i.e., once each for SBP and DBP), we applied a Bonferroni correction to protect against Type I error. Only nominal *p*-values less than 0.025 (equals 0.05 divided by 2) were judged to be statistically significant.

All models included demographic covariates (i.e., gender and race) as well as BMI and posture. Analyses were repeated with SES, personality and life stress, and substance consumption covariates. Finally, to determine if the effects of lifetime exposure to racism on ABP were a function of recent or chronic experiences, a measure of recent exposure to racism (Past Week Discrimination) was added to the models.

When interactions of Age \times Lifetime Discrimination were significant, interaction effects were probed using the methods described by Holmbeck (2002) for evaluating interactions of two continuous variables. We created terms reflecting age scores one standard deviation above and below the mean to use in the post-hoc analyses and figures. In exploratory analyses designed to determine which dimensions of racism were associated with age differences in ABP outcomes, we repeated the significant main effect and interaction analyses substituting each of the subscales (Threat/Harassment, Stigmatization, Social Exclusion, and Workplace Discrimination) for the Lifetime Discrimination score followed by examination of the effects for younger and older participants. As we are examining effects of four different subscales, we again apply a Bonferroni correction and accept as significant nominal *p* values $< .0125$ (.05 divided by 4).

RESULTS

Age differences in hypertensive diagnosis

Overall, there were significant differences in the proportion of older versus younger participants categorized as hypertensive using daytime ABP as shown in Table 1 ($\chi^2(3, N=607) = 10.45, p < 0.02$).

Age Variations in Key Variables

As shown in Table 1, older participants were more likely to be men; whereas younger participants were more likely to be women, although the effects fall short of significance ($\chi^2(1, N=607) = 3.68, p = .055$). Older participants had lower levels of income than younger participants ($\chi^2(3, N=606) = 20.97, p < .0001$). Older participants were significantly more likely than younger participants to smoke on the day of testing ($\chi^2(1, N=607) = 646, p < .02$), and to smoke on proportionately more observations ($F(1,605) = 14.02, p < .001$). Older participants also tended to consume caffeine on a greater proportion of observations than did younger participants ($F(1,604) = 3.74, p = .05$). Older participants had higher daytime SBP ($F(1,605) = 8.92, p < .01$); daytime DBP ($F(1,605) = 26.12, p < .001$); and nocturnal DBP ($F(1,391) = 9.74, p < .002$), than younger participants.

Sociodemographic differences in those with and without sleep ABP data

Of the 607 participants with complete data, 393 participants (64.9%) wore the ABP monitor while they slept. The individuals who wore the monitor while they slept had significantly lower BMI ($M = 27.7$ vs. $M = 29.05, F(1,605) = 8.17, p < .01$), and were slightly, but not significantly older ($M = 39.64$ years, $SD = 9.60$ vs. $M = 38.15$ years, $SD = 9.34, F(1,605) = 3.37, p = .07$). However, those who wore the monitor during the night did not differ from those who did not wear the ABP monitor at night on gender ($\chi^2(1, N=607) = 1.06, p = .30$), race ($\chi^2(1, N=607) = 2.96, p = .09$), lifetime discrimination ($F(1,605) = 2.46, p = .12$), daytime SBP ($F(1,605) = .01, p = .92$), daytime DBP ($F(1,605) = .17, p = .68$), cynical hostility ($F(1,579) = .21, p = .65$), stressful life events ($F(1,565) = .65, p = .42$), education ($\chi^2(2, N=606) = 3.46, p = .18$), or poverty level ($\chi^2(3, N=606) = 2.65, p = .45$).

Sampling interval and mean number of measurements for ABP

Artifactual ABP readings were excluded following procedures outlined in Brondolo, Libby et al. (2008). In this sample, all SBP readings were between 97-167 mmHg and all DBP readings were between 57-102 mmHg. Excluding baseline, participants had an average of 28.79 ($SD = 10.52$; range 1 – 58) waking readings and an average of 4.58 ($SD = 2.67$; range 1 – 17) nighttime readings based on participants self-reported sleep time. BP values are shown in Table 1.

Evaluating potential covariates

Based on significant associations among variables depicted in Table 2 and significant associations of ABP to SES indicators (data not shown), all analyses of the relations of age and/or discrimination to SBP and DBP include the between-person demographic covariates (i.e., race, and gender), BMI, and the within-person covariate of posture. We also test models

incorporating the SES covariates (i.e., education and poverty level) and the personality and life stress covariates (i.e., cynicism and sum of life stressors). For daytime ABP, covariates also include within-person measures of substance consumption (i.e., observation level measures of smoking, alcohol use and caffeine use). For 24-hour and sleep ABP analyses, covariates include the between-person measures of the proportions of readings in which caffeine and alcohol were consumed.

Main effects of Lifetime Discrimination on resting office and baseline ambulatory BP

Two sets of regression analyses examine the main effect of Lifetime Discrimination on office resting BP and day-of-testing, resting baseline ABP. Covariates included age, gender, race, and BMI. Neither the main effect of Lifetime Discrimination on resting office SBP ($B = -.33$, $SE = .88$, $t(586) = -.38$, $p = .70$) nor DBP ($B = -.71$, $SE = .64$, $t(586) = -1.10$, $p = .27$) were significant, nor were the effects of Lifetime Discrimination on day-of-testing baseline SBP ($B = .89$, $SE = .81$, $t(596) = 1.09$, $p = .27$) or DBP ($B = .77$, $SE = .56$, $t(596) = 1.39$, $p = .17$). Analyses were repeated with the addition of the interaction of Age \times Lifetime Discrimination in the model. The interactions were not significant for either office resting SBP ($p = .85$) or office resting DBP ($p = .16$) or day of testing, baseline SBP ($p = .53$) or DBP ($p = .20$).

Main effects of Lifetime Discrimination on ABP

Mixed models regression analyses examined the main effect of discrimination on 24-hour ABP as well as daytime and nocturnal BP. There were no main effects of Lifetime Discrimination on 24-hour SBP or 24-hour DBP, nor were there main effects on daytime SBP or daytime DBP. There was a trend toward a significant main effect of Lifetime Discrimination on nocturnal SBP ($B = 3.13$, $SE = 1.52$, $t(381) = 2.06$, $p = .04$) controlling for demographic covariates (i.e., gender, race, BMI, and posture) and controlling for demographics, SES, personality, life stress, and substance consumption covariates ($B = 3.13$, $SE = 1.61$, $t(333) = 1.94$, $p = .05$). The effects of Lifetime Discrimination were significant when analyses were restricted to the subset of the sample ($n = 262$) with 3 or more nocturnal readings and all covariates ($B = 4.75$, $SE = 1.84$, $t(247) = 2.58$, $p < .013$). The effects remained significant when measures of recent exposure to discrimination (i.e., Past Week Exposure scale) were included ($B = 5.47$, $SE = 2.40$, $t(245) = 2.28$, $p < .025$). The effect of Lifetime Discrimination on nocturnal DBP was in the same direction, but was not significant ($B = 1.85$, $SE = .99$, $t(365) = 1.87$, $p = .06$).

Interactions of Age and Lifetime Discrimination on ABP

To determine if the hypothesized interactions of Age \times Lifetime Discrimination were modified further by race/ethnicity or gender, we first examined three-way interactions of Race \times Age \times Lifetime Discrimination and Gender \times Age \times Lifetime Discrimination in separate analyses containing all main effects and two and three-way interactions (data not shown). None of the three-way interactions were significant (ps range from .08 to .76), and therefore the three-way interaction terms were removed from all subsequent models.

Controlling for demographic covariates and with main effects in the models, the interaction of Age \times Lifetime Discrimination was significant for 24-hour DBP ($B = .14$, $SE = .06$, t

(611) = 2.49, $p = .014$) and remained significant controlling for all SES, posture, personality and life stress, and substance consumption covariates ($B = .16$, $SE = .06$, $t(538) = 2.64$, $p = .0085$). Follow-up analyses revealed a significant Age \times Lifetime Discrimination interaction for daytime DBP ($B = .13$, $SE = .06$, $t(613) = 2.35$, $p = .019$) which remained significant after controlling for all SES, personality and life stress, and observation level substance consumption covariates, including caffeine ($B = .14$, $SE = .06$, $t(534) = 2.33$, $p = .02$). The interactions of Age \times Lifetime Discrimination on 24-hour DBP ($B = .16$, $SE = .06$, $t(533) = 2.33$, $p = .02$) and on daytime DBP ($B = .15$, $SE = .06$, $t(533) = 2.36$, $p = .01$) remained significant with the addition of the measure of Past Week Discrimination. In contrast, controlling for demographics, BMI and posture, the interaction of Age \times Lifetime Discrimination was not significant for nocturnal DBP ($B = .16$, $SE = .11$, $t(361) = 1.48$, $p = .14$). The interactions with age were also not significant for 24-hour ($p = .11$), daytime ($p = .12$) or nocturnal SBP ($p = .17$).

Figures 1a and b depict the interaction of Age \times Lifetime Discrimination on 24-hour and daytime DBP, controlling for all covariates. Post-hoc probing of the significant interaction effects on 24-hour and daytime DBP were conducted following the recommendations of Holmbeck (2002) and performed on the models adjusted for all covariates. Among older participants discrimination was positively associated with 24-hour DBP ($B = 2.58$, $SE = 0.77$, $t = 3.34$, $p < .001$) and daytime DBP ($B = 2.53$, $SE = 0.77$, $t = 3.30$, $p < .001$) and remained significant with Past Week Discrimination in the model ($ps < .01$). The effects were not significant for younger participants (ps range .32 – .71).

Subscale analyses

To restrict the number of different analyses, we confine hypothesis testing to an examination of the main effects of each subscale on nocturnal SBP and to the interaction of Age \times Discrimination on 24-hour DBP. We repeat the analyses four times, substituting each subscale scores for the Lifetime Discrimination score. All analyses controlled for demographic, socioeconomic, personality and substance consumption covariates. None of the subscales was significantly associated with nocturnal SBP, although there was a trend for the threat harassment subscale ($B = 3.71$, $SE = 1.45$, $t(339) = 2.56$, $p < .02$). The analyses of the Age \times Discrimination interactions on 24-hour DBP revealed significant effects for the subscale of social exclusion ($B = 0.17$, $SE = 0.05$, $t(539) = 3.53$, $p < .0004$). There was a trend towards a significant association for workplace discrimination ($B = .11$, $SE = .05$, $t(539) = 2.56$, $p < .02$), and stigmatization ($B = 0.13$, $SE = 0.05$, $t(539) = 2.48$, $p < .02$). In contrast, effects were not significant when analyses include the threat/harassment subscale ($p > .40$). For 24-hour DBP, the effects for social exclusion, workplace discrimination, and stigmatization were significant for older participants (ps range from .01 – .001) but not for younger participants (ps range from .31 – .94).

Interactions of Age \times Lifetime Discrimination on Dipping Status

A total of 36.9% ($n = 145$) participants met criteria for SBP dipping, and 50.6% ($n = 199$) met criteria for DBP dipping status. Controlling for age, race, gender and BMI, the interaction of Age \times Lifetime Discrimination approached significance (Wald's $X^2 = 3.65$, $p = .056$) for SBP dipping. For older participants the relationship of lifetime discrimination to

non-dipping was significant (OR = 1.62, $p < .03$, Wald's 95% CI [1.05, 2.49]), whereas for younger adults, the relationship was non-significant (OR = .92, $p < .73$, Wald's CI [.57, 1.47]). The Age \times Lifetime Discrimination interaction was not significant (Wald's $X^2 = 1.16$, $p < .28$) for DBP dipping.

Discussion

The chronic nature of race-related stress has led investigators to speculate that the effects of racism/ethnic discrimination on BP would be stronger among older (versus younger) individuals (Peters, 2004). To our knowledge, no previous studies have examined age differences in the relationship of lifetime exposure to racism and ABP. We examined these effects in a large sample of urban dwelling African American and Latino(a) adults.

We found the relation of lifetime discrimination to 24-hour and daytime measures of DBP were indeed moderated by age, even after adjustment for demographic factors, BMI, personality and life stress, substance consumption, and recent exposure to discrimination. In each case, the relationship of racism to DBP was significant for older but not younger individuals. In contrast, age did not moderate the relationship of discrimination to resting BP or nocturnal BP. There was a significant positive relationship of discrimination to nocturnal ABP, which is consistent with findings from the existing literature (see reviews by Brondolo et al., 2011; Doleszar et al., 2014). Neither race nor gender was a significant moderator of the effects of lifetime discrimination on any measure of ABP.

These observed age differences in the effects of discrimination on ambulatory DBP could be a function of cohort effects, and/or cumulative changes in both psychological and physiological processes. Longitudinal studies suggest that health in adulthood may be shaped, in part, by characteristics of the social environment, including the political, cultural, and economic climate at the time of the individual's birth and development (Gee et al., 2012; Twenge & Crocker, 2002). The chronological period into which an individual was born influences the social context in which racism was experienced and the types of racism to which individuals were exposed. In turn, these cohort differences in the experiences of discrimination may influence the underlying psychobiological processes elicited in response to discriminatory events.

The older individuals in our study were all born prior to the Civil Rights Act of 1968. Black and Latino(a) individuals raised prior to the Civil Rights Movement may have been reared in families in which racism restricted social and economic opportunities. Persistent economic inequality may have affected the opportunities available to the older adults over the course of their development. In fact, in this sample, older adults had significantly lower levels of income than did younger adults.

Our data suggest that the intensity and types of discrimination reported by younger and older individuals do not appear to differ. However, research suggests that qualitative aspects of racist events have changed in the past several decades, with the communication of racial bias delivered in more subtle and less overt ways (Dovidio & Gaertner, 2004). Older adults may have experienced more blatant experiences of racism early in life. These experiences may

influence and potentially intensify reactions to later exposures to race-related stressors (Costello, 2014).

Specifically, cohort differences in the social context of discrimination may result in cohort differences in the underlying pattern of acute cognitive, affective, behavioral and biological responses to episodes of racism and other sources of stress. In turn, these acute experiences may shape more enduring psychological processes, including the development of attitudes or schemas about the self, others, and the world (Brondolo, Ng, Jean Pierre, & Lane, in press). Self-schemas, including self-esteem and other psychological resources may help buffer the psychophysiological demands of chronic stressors, including racism (Martens, Greenberg, & Allen, 2008). Consequently, the effects of racism on the development of these psychological resources may have rendered older adults less able to effectively buffer stress.

The subscale analyses are consistent with this hypothesis. Specifically, age differences in the association of discrimination to 24-hour DBP were found for primarily for race-related social exclusion, but were not seen for race-related threat/harassment. One possibility is that the cumulative effects of lifetime discrimination during direct social exchanges influence exposure to and perceptions of other social experiences, altering cardiovascular responses to daily interactions (Brondolo, Brady et al., 2008). Other forms of race-related stress, including those which are more severe or physically threatening, appear to be more closely related to nocturnal ABP, and these effects may be seen regardless of age (Wilson, Kliever, & Sica, 2004).

Consistent with other reports, the relationship of discrimination to resting BP was not significant (Brondolo et al., 2011). The potential effects of racism on the underlying psychological processes that govern stress reactivity and recovery may explain why the effects of racism are not apparent in measures of baseline or resting BP. Baseline or clinic measures are generally obtained in quiet and supportive settings in which efforts are made to ensure the comfort of the participant. It may be more difficult to detect the effects of underlying psychological processes on BP reactivity in these controlled, relatively less stressful circumstances in which a limited number of recordings are obtained.

The cumulative exposure to discrimination and other race-related stressors also may potentiate physiological changes in BP reactivity to stress that increase risk for HTN over the long run, consistent with the weathering hypothesis (Geronimus, Hicken, Keene, & Bound, 2006) and models of the role of background stress (Gump & Matthews, 1999). There may also be age-related changes in the cardiovascular system that exacerbate BP reactivity to stress. For example, age related decreases in arterial elasticity can lead to increased arterial stiffness (Pinto, 2007). Age-related increases in reactivity to sympathetic nervous system reactivity and decreased baroreceptor sensitivity may also exacerbate BP responses to stress (Pinto, 2007). Further research on the processes through which race-related stress influences underlying hemodynamic changes over the life course would be valuable.

The current findings should be considered in light of several limitations. First, this study was cross-sectional and precludes the assessment of causality in the linkages identified. Second, we did not evaluate age-related changes in affective responses or coping in response to

racism. We also do not have direct measures of changes in vascular reactivity or other dimensions of the cardiovascular system that might drive ABP responses. Our sample of Latino(a)s was largely comprised of Puerto Rican individuals limiting our ability to generalize to other Latino(a) subgroups. This group has not shown the health advantages observed in other Latino(a) ancestry groups in line with the Hispanic/Latino(a) health paradox (Ruiz, Steffen & Smith, 2013). We measure exposure to life stressors included in the sample, but not the individual's perceptions of these stressors, specific non-race related stressors, nor do we capture other environmental stressors identified as predictors of health outcomes (Myers, 2009). It is possible that our participants represented selectively surviving individuals. Given the high levels of HTN in Black individuals in particular, it is possible that our exclusion criteria, including treatment for hypertension, influenced the nature of the sample and the associations observed. However, there were many hypertensive individuals included. With regard to our measurement of lifetime racism, we did not explicitly ask about the number of times they had the experiences assessed by the PEDQ-CV, thus it is unclear whether there are absolute differences in the frequency of exposure.

In sum, the current findings provide support for the conceptualization of racism as a chronic stressor in the lives of racial/ethnic minorities. The current findings represent a strong start towards understanding how exposure to racial and ethnic discrimination across the life course may influence HTN outcomes among Blacks and Latino(a)s. Future studies should seek to examine the psychobiological processes through which discrimination may affect stress reactivity and recovery, and therefore affect health. Longitudinal analyses can clarify the relationship of race-related stress to the development of CVD. A life-course perspective can help shape our understanding of the ways in which discrimination shapes opportunities for optimal health and functioning.

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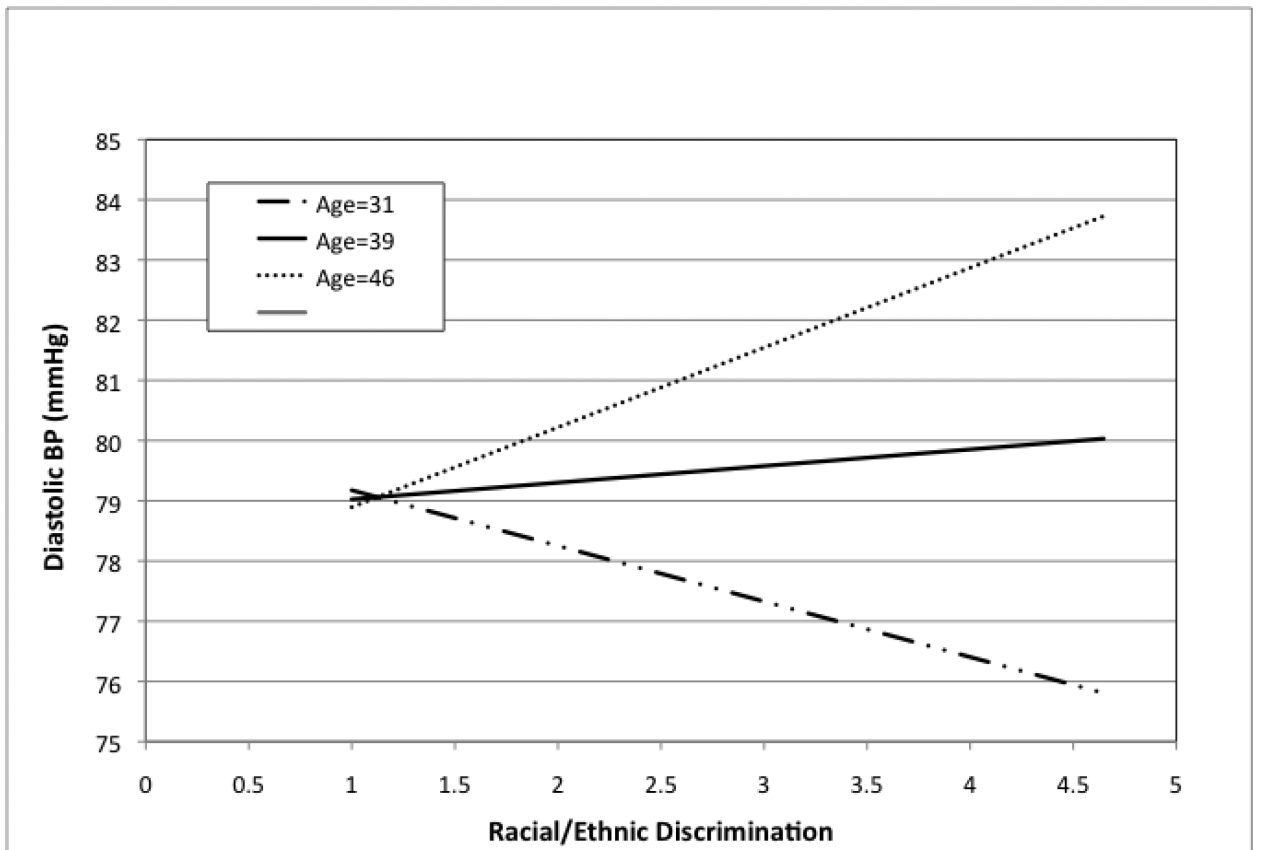


Figure 1a. Age Moderates the Effects of Lifetime Racial/Ethnic Discrimination on 24-Hour Ambulatory Diastolic Blood Pressure. Estimates adjusted for all covariates.

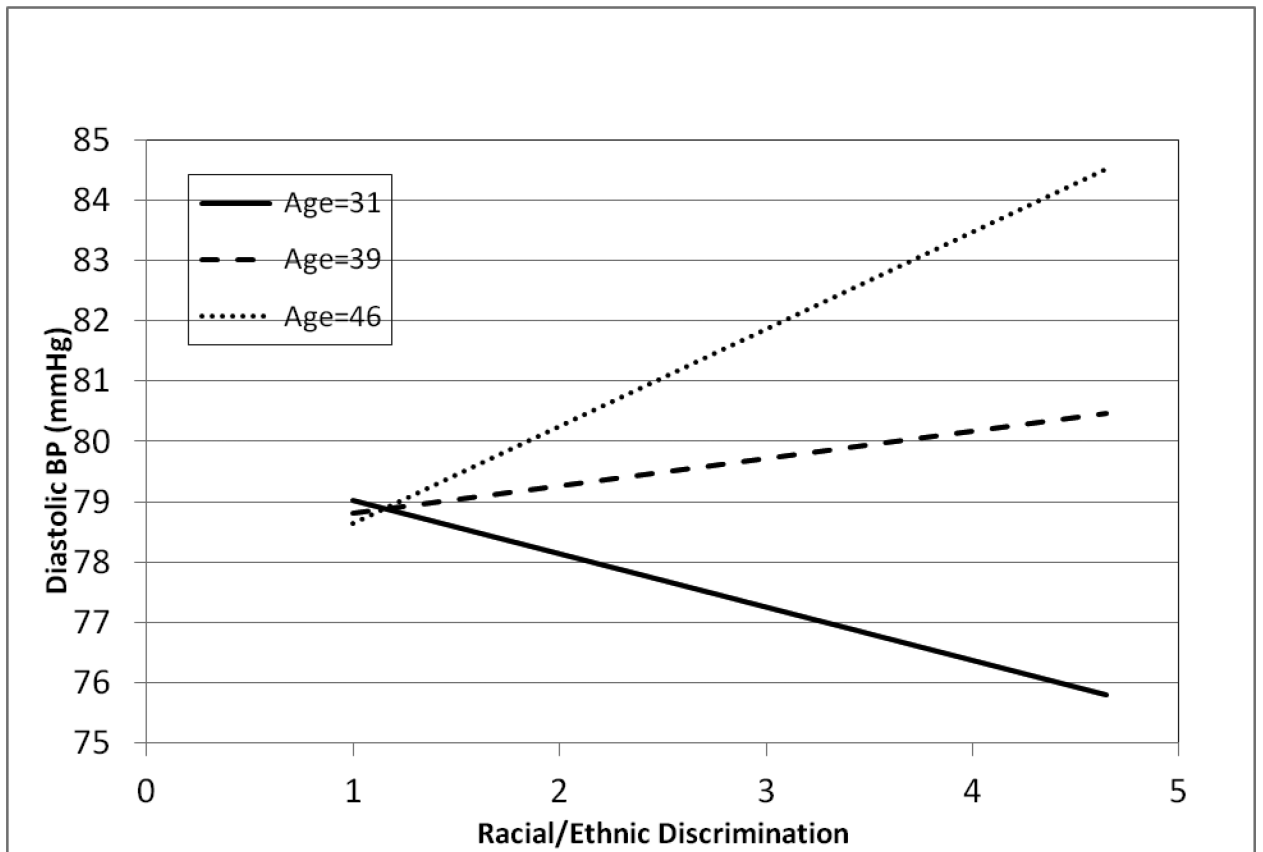


Figure 1b. Age Moderates the Effects of Lifetime Racial/Ethnic Discrimination on Daytime Ambulatory Diastolic Blood Pressure. Estimates adjusted for all covariates.

Table 1

Study Variables for the Full Sample and Stratified on Age

	Full Sample	< 39 Years Old	39 Years Old
Demographic Factors			
Age (mean, (SD))	39.11 (9.53)	31.40 (4.77)	47.17 (5.88)
Race (n (%))			
Black	318 (52.39%)	155 (50.00%)	163 (54.88%)
Latino	289 (47.61%)	155 (50.00%)	134 (45.12%)
Gender (n (%))			
Female	298 (49.09%)	164 (52.90%)	134 (45.12%) [†]
Male	309 (50.91%)	146 (47.10%)	163 (54.88%)
Body Mass Index (mean, (SD))	28.19 (5.46)	27.80 (4.77)	28.60 (5.52)
Socioeconomic Factors (n (%))			
Poverty Level			
1× poverty level	241 (39.77%)	108 (34.95%)	133 (44.78%) ^{**}
2× poverty level	143 (23.60%)	61 (19.74%)	82 (27.61%)
3× poverty level	79 (13.04%)	52 (16.83%)	27 (9.09%)
> 3 poverty level	143 (23.60%)	88 (28.48%)	55 (18.52%)
Educational Attainment (n (%))			
< H.S.	177 (29.21%)	96 (30.97%)	81 (27.36%)
H.S.	314 (51.82%)	152 (49.03%)	162 (54.73%)
College	115 (18.98%)	62 (20.00%)	53 (17.91%)
Substance Consumption			
Proportion of readings w/caffeine (SD)	.12(.14)	.11 (.12)	.12 (.16)
Proportion of readings w/alcohol (SD)	.04(.12)	.04 (.10)	.05 (.13)
Smokers (n, (%))	334 (55%)	155 (50%)	179 (60%)
Proportion of readings w/smoking (SD)	.20 (.25)	.16 (.22)	.24 (.27)
Psychosocial Factors^a (mean, (SD))			
Cynicism	.51 (.25)	.50 (.25)	.52 (.24)
Sum of Life Stressors	16.70 (19.34)	17.01 (19.64)	16.38 (19.05)
Hypertensive status ^f (n, (%))			
Normotensive	152 (25.4%)	89 (28.71%)	63 (21.21%)
High Normal	199 (32.78%)	102 (32.90%)	97 (32.66%)
Stage 1	232 (38.22%)	113 (36.45%)	119 (40.07%)
Stage 2	24 (3.95%)	6 (1.94%)	18 (6.06%)
Predictors (mean, (SD))			
Lifetime Racism			
PEDQ-CV Full Scale Measure	2.16 (.70)	2.14 (.67)	2.17 (.73)
Social Exclusion	2.52 (.80)	2.52 (.78)	2.52 (.82)
Stigmatization	1.99 (.85)	1.98 (.84)	2.00 (.86)

	Full Sample	< 39 Years Old	39 Years Old
Workplace Discrimination	2.21 (.85)	2.20 (.81)	2.23 (.89)
Threat/Harassment	1.69 (.76)	1.65 (.74)	1.73 (.79)
Outcomes (mean, (SD))			
Ambulatory Blood Pressure			
Daytime SBP	133.14 (15.46)	131.32 (15.32)	135.04 (15.39) **
Nighttime SBP	125.50 (21.29)	123.97 (21.51)	126.97 (21.04)
Daytime DBP	79.50 (9.84)	77.54 (9.08)	81.55 (10.20) **
Nighttime DBP	72.16 (14.76)	69.81 (15.17)	74.40 (14.02) **

¹In comparison to younger participants (i.e., less than 39 years of age), older participants were less likely to have normal blood pressure (i.e., < 120 SBP and < 80 DBP: older = 41.9% vs. younger = 58.8%) and more likely to have Stage 2 hypertension (i.e., SBP of 160 mmHg or higher or DBP of 100 mmHg or higher; older = 75% vs. younger = 25%). The proportions of older and younger adults classified as having prehypertension (i.e., SBP of 120-139 mmHg or DBP from 80-89 mmHg; older = 51.5% vs. younger = 48.5%) or Stage 1 hypertension (i.e., SBP from 140-159 mmHg or DBP from 90-99 mmHg; older = 51.3% vs. younger = 48.7%) were not significantly different.

[†] = $p < .06$

** = $p < .01$

^aSlightly fewer individuals completed the measures of cynicism ($n = 581$) and life stress ($n = 567$) because of technical problems administering the questionnaires.

Table 2

Correlations of covariates (BMI, personality, life stress, and substance consumption) to measures of discrimination and ABP.

Variables	Sum of Life Stressors	Cynical Hostility	Proportion of readings with Caffeine consumption	Proportion of readings with alcohol consumption	Proportion of readings accompanied by smoking	BMI
PEDQ-CV - Lifetime Discrimination	.03	.01	.03	.07	.16 ^{****}	.07
PEDQ-CV subscales						
Social Exclusion	.04	.02	.02	.01	.11 ^{**}	.05
Stigmatization	.00	.03	.03	.12 ^{**}	.19 ^{****}	.05
Workplace Discrimination	.04	-.02	-.01	.03	.05	.08
Threat	.12 ^{**}	.01	.05	.11 ^{**}	.16 ^{****}	-.03
Past week mn	.03	.03	.09 [*]	.04	.17 ^{****}	-.02
Ambulatory Blood Pressure						
24-hour SBP	-.01	.02	.01	.16 ^{***}	.15 ^{***}	.25 ^{***}
24-hour DBP	.04	.01	.04	.19 ^{***}	.19 ^{***}	.20 ^{***}
Daytime SBP	-.02	.02	.00	.16 ^{****}	.15 ^{****}	.22 ^{****}
Nocturnal SBP	-.04	.09	.07	.02	.13 [*]	.14 ^{**}
Daytime DBP	.04	.02	.03	.18 ^{****}	.19 ^{****}	.17 ^{****}
Nocturnal DBP	.01	.06	.07	.09	.14 ^{**}	.12 [*]

* = $p < .05$

** = $p < .01$

*** = $p < .001$

**** = $p < .0001$