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## Perceived Discrimination and Nocturnal Blood Pressure Dipping Among Hispanics: the Influence of Social Support and Race

Carlos J. Rodriguez, MD, MPH<sup>1,2</sup>, TanYa M. Gwathmey, PhD<sup>3</sup>, Zhezhen Jin, PhD<sup>4</sup>, Joseph Schwartz, PhD<sup>5</sup>, Bettina M. Beech, DrPH, MPH<sup>1,2</sup>, Ralph L. Sacco, MD, MS<sup>6</sup>, Marco R. Di Tullio, MD<sup>7</sup>, and Shunichi Homma, MD<sup>7</sup>

<sup>1</sup>Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest School of Medicine

<sup>2</sup>Department of Internal Medicine, Wake Forest School of Medicine

<sup>3</sup>Department of Surgery, Hypertension and Vascular Research Center, Wake Forest School of Medicine

<sup>4</sup>Department of Biostatistics, Mailman School of Public Health, Columbia University

<sup>5</sup>Department of Psychiatry, Stony Brook University

<sup>6</sup>Department of Neurology, University of Miami, Miller School of Medicine

<sup>7</sup>Department of Medicine, New York Presbyterian Hospital, Columbia University Medical Center

### Abstract

**Objective**—Little is known about the relationship of perceived racism to ambulatory blood pressure (ABP) in Hispanics. We explored possible associations between ABP nocturnal dipping and perceived racism in a Hispanic cohort.

**Methods**—Participants included 180 community-dwelling Hispanics from the Northern Manhattan Study. Measures included perceived racism, socioeconomic status, social support, and ABP monitoring. Nocturnal ABP non-dipping was defined as a less than 10% decline in the average asleep systolic BP (SBP) relative to the awake SBP.

**Results**—Overall, 77.8% of participants reported some form of perceived racism [Perceived Ethnic Discrimination Questionnaire (PEDQ) scores >1.0]. Greater social support was associated with less perceived discrimination (Spearman  $r=-0.54$ ;  $p<0.001$ ). Those with higher perceived discrimination scores reported more depressive symptoms ( $r=0.25$ ;  $p<0.001$ ). Those with higher PEDQ scores were less likely to show nocturnal ABP non-dipping in multivariate models (OR=0.40, CI=0.17–0.98;  $p=0.045$ ). Among those with low perceived racism, black Hispanic participants were more likely to have nocturnal ABP non-dipping (82.6%) compared to white Hispanics (53.9%;  $p=0.02$ ). Among those with high perceived racism, no associations between

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Correspondence: Carlos Jose Rodriguez MD, MPH, Division of Public Health Sciences, Wake Forest School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157, (o) 336-713-1648; (f) 336-713-4300.

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race and the prevalence of ABP non-dipping was found (black Hispanic=61.5% vs. white Hispanic=51.4%,  $p=0.39$ ;  $p$  interaction=0.89).

**Conclusions**—Perceived racism is relatively common among US Hispanics and is associated with ABP. Non-dipping of ABP, a potential cardiovascular risk factor, was more common in black-Hispanic participants with low perceived racism. This finding may reflect different coping mechanisms between black versus white Hispanics and related blood pressure levels during daytime exposures to discrimination.

## Keywords

Blood Pressure; Ambulatory Blood Pressure; Hispanics; Perceived Discrimination; Social Support; Race

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The absence of nocturnal ambulatory blood pressure (ABP) dipping (i.e., normal decreases in BP during nighttime hours) is more closely related to cardiovascular morbidity and mortality than clinic BP.<sup>1, 2</sup> Perceived racism is an important psychosocial stressor that likely contributes to the elevated rates of hypertension, elevated nocturnal SBP and ABP non-dipping among non-Hispanic black Americans.<sup>3–9</sup> Hispanics are the largest and most rapidly growing minority ethnic group in the United States (US). Hispanics are racially and ethnically diverse with Native American, European, and West African admixture in addition to subgroup identification based mostly on country of origin.<sup>10, 11</sup> Hispanics can be of any race and thus may self-identify as Hispanic-black or Hispanic-white making Hispanics at risk not only for *ethnic discrimination*, based on culture of origin, but also for *racial discrimination* based on phenotypic characteristics of race.<sup>12, 13</sup> However, the relationship of perceived racism and BP among Hispanics has been less explored since virtually all of what is known regarding perceived racism and ABP is in non-Hispanic blacks.<sup>12</sup> Only one study included Hispanics, but results for the sample of 94 Hispanics in that study were not reported exclusive of the 151 non-Hispanic blacks in the cohort.<sup>3</sup> Among Hispanics, social support and depressive symptomatology are associated with perceived discrimination and thus may affect the relationship of racism to ABP as potential moderator and/or mediators with regard to the ability to cope with the exposure.<sup>14, 15</sup> Further, it is important to understand whether the same effects of racism on ABP are seen in non-Hispanic blacks are also present among Hispanics, because there is some evidence that despite a high level of health risk factors and greater socioeconomic disadvantage; Hispanics do not necessarily show the same patterns of cardiovascular health as would be expected.<sup>16, 17</sup> The goal of the present study was to identify correlates of perceived discrimination, including psychosocial aspects such as social support and depression, and investigate the relationship of perceived racism to ABP in a larger, exclusive sample of Hispanics. We hypothesized that high perceived racism would be associated with higher levels of ABP. We also examined whether this association differed between black vs. white Hispanics.

## METHODS

The Northern Manhattan Study (NOMAS) is a community-based prospective cohort study ongoing since 1992. The methods of subject recruitment and enrollment into NOMAS have been described elsewhere.<sup>18</sup> Briefly, participants were eligible if they: (1) had never been

diagnosed with a stroke; (2) were over the age of 39 years; and (3) resided in Northern Manhattan for at least 3 months in a household with a telephone. Assessments were conducted in English or Spanish, depending on the primary language of the participant. The study was approved by the Columbia University and University of Miami Institutional Review Boards. All participants gave informed consent.

Smoking status and body mass index (BMI) were collected as part of NOMAS and are included as covariates for this analysis. Smoking status was assessed by self-report, defined as current or ever smoking cigarettes. Height (in inches) and weight (in pounds) measurements were obtained by trained research staff with the use of calibrated scales. As part of this ABP ancillary study, additional psychosocial variables and ABP measures were obtained on a subset of 180 Hispanic participants recruited from the NOMAS between December 2006 and February 2011. We excluded participants who: (a) were taking antihypertensive medication; (b) had clinical cardiovascular disease (defined as myocardial infarction or stroke at baseline or most recent follow up); (c) manifested severe hypertension (based on the average of two resting BP measurements  $\geq 220$  mmHg systolic, or  $\geq 110$  mmHg diastolic); or (d) arm circumference  $>47$ cm, the size of our largest ABP cuff. Most ABP measures were obtained concurrently with the Cardiovascular Abnormalities and Brain Lesions study,<sup>19</sup> a separate ancillary study also based on the NOMAS cohort.

Race–ethnicity was based on self-identification through interview questions modeled after the 2000 US census. All participants were asked whether they were Hispanic and then asked to self-identify as black or white. It was explained that being Hispanic is not a race and identifying as black Hispanic or white Hispanic is distinct from being non-Hispanic black or non-Hispanic white. Spanish versions of all questionnaires were available and all questionnaires were administered by trained research staff. This ancillary study was approved by the Columbia University Institutional Review Board. All participants gave informed consent to participate in the study.

## **ABP measures**

ABP was measured using the Spacelabs 90207 or 90217 ABP monitor (Spacelabs Healthcare, Redmond, WA). The accuracy and reliability of the device has been previously validated.<sup>20, 21</sup> Before use, each device was calibrated with a reference mercury manometer for target agreement within  $\pm 5$  mmHg. Untreated hypertensives were defined based on the average of two resting BP measurements  $\geq 140/90$  mmHg. An appropriately sized BP cuff was placed on the subject's non-dominant arm and the ABP monitor was programmed to automatically take a reading every 15 minutes during waking hours, and every 30 minutes during sleep over a 24-hour period. The average awake and nighttime (sleep) systolic and diastolic BP values were computed using participant diary-entered reports of sleep onset and wake-up times. Thus 24-hour systolic BP (SBP), 24-hour diastolic BP (DBP), daytime SBP, daytime DBP, nighttime SBP and nighttime DBP constitute the primary components of the ABP assessment. Only one participant had to repeat the ABP assessment due to initial poor-quality recordings. Otherwise there were no protocol violations, technical failures or insufficient number of ABP readings. The average numbers of daytime, nighttime, and total valid readings/subject were: 51.65 (SD=7.92, range: 33–73), 18.85 (SD=5.51, range: 5–30),

and 71.50 (SD=6.76, range: 54–83) respectively. Normal nighttime BP dipping is defined as a >10% decrease in the average nighttime systolic or diastolic BP relative to average daytime levels. The ABP night-day ratio was calculated as average nighttime BP/daytime BP and used as a measure of nighttime BP dipping in accordance with prior studies.<sup>22, 23</sup> ABP non-dipping was defined as a nocturnal decline in SBP of less than 10% relative to awake SBP,<sup>24</sup> which translates to a value of 0.9 or higher for the ABP night-day ratio. Thus, individuals were assigned to two categories based on the ABP night-day ratio (Dippers: ratio < .90 vs. Non-dippers: ratio > .90).

### Perceived Racism

Perceived racism was assessed using the brief Perceived Ethnic Discrimination Questionnaire – Community Version (PEDQ-CV).<sup>25</sup> The psychometric properties, reliability, and construct validity of the brief PEDQ-CV has been evaluated in a large multi-ethnic sample of community-dwelling adults.<sup>25</sup> The brief PEDQ-CV assesses lifetime exposures of ethnic discrimination within a social or interpersonal context using a 17-item scale in which each item begins with the phrase, “Because of your ethnicity/race....” and ends with a description of a specific event or negative social interaction. The items measure several sub-dimensions of racism, including social exclusion, workplace discrimination, stigmatization, and physical threat, permitting comprehensive examination of race-ethnicity related stressors. Each item is rated on a Likert scale from 1 to 5, where 1 = never and 5 = very often. Item scores are then added and divided by the total number of items to produce a mean score with a continuous data range from 1.0 to 5.0. For example, a mean score of 2.2 (38 total points/17 items) would suggest that, on average, racism or ethnic discrimination was experienced *at least occasionally* over the lifetime. A mean score of 1.1 (20 total points/17 items) would suggest that some type of racism or ethnic discrimination was experienced *at least once* over the lifetime. Participants were asked to complete the existing questionnaire independently, but with a trained research team member available for assistance. The PEDQ has shown high internal consistency (Cronbach’s alpha coefficient values of 0.95 for the full scale and 0.74 to 0.87 for the subscales).<sup>3</sup>

### Socioeconomic Status

As a primary indicator of socio-economic status (SES), each study participant reported the years of completed education. Family annual income was examined from five categories (less than \$5000; \$5000 to \$15,999; \$16,000 to \$34,999; \$35,000 to \$74,999; and \$75,000 or more).

### Social Support

The CARDIA Social Support Scale (CSSS) has been validated and described in previous studies<sup>26, 27</sup> to assess instrumental support (four items), network adequacy (four items), emotional support (one item), and a social network index (two items). The total score determines the overall amount of support available to the individual. The Cronbach’s alpha of the CSSS items used in our study is 0.74, which shows good internal consistency.

## Depressive Symptoms

The Center for Epidemiological Studies Depression (CES-D) scale is designed to measure depressive symptomatology.<sup>28</sup> The CES-D evaluates depressed affect, somatic symptoms, positive affect, and interpersonal relations, thus encompassing the major components of depressive symptoms. Higher scores reflect a higher degree of depressive symptoms. High internal consistency has been reported with Cronbach's alpha coefficients ranging from 0.85 to 0.90 across studies.<sup>29</sup>

## Statistical Analysis

Baseline characteristics of participants are presented as means  $\pm$  SD for continuous variables and proportions for categorical variables for the overall population and according to PEDQ score tertiles defined as: T1: 1.00 – 1.12; T2: 1.13 – 1.35; T3: 1.36 – 3.70. Differences across PEDQ tertiles for each characteristic were assessed using analysis of variance (ANOVA) for continuous variables and  $\chi^2$  test for categorical variables. Cumulative frequency analysis was used to obtain the relative frequency distribution of PEDQ scores across the cohort. The relationship between continuous variables was examined with Spearman  $r$  coefficients. Although primarily analyses used continuous scores, for descriptive purposes dichotomized scores were examined as well: *high social support*, *high perceived discrimination*, and *high educational and income status* were defined based on median splits for CSSS, PEDQ, education and income levels respectively. A CES-D score of 16 or higher was used to categorize *high depressive symptoms* according to prior studies.<sup>30</sup> ABP night-day ratio was the primary outcome variable. Binary dipping/non-dipping status was an important secondary outcome variable.<sup>31–34</sup> Linear and logistic regression univariate modeling was used to assess the association of PEDQ score with ABP night-day ratio and dipping status respectively. To adjust for variables with established effects on ABP dipping, age, sex, BMI, and tobacco use were selected as covariates in subsequent multivariate modeling.<sup>35</sup> We assessed the patterns of mean awake and sleep systolic and diastolic ABP components across the continuous PEDQ score. The curvilinear relationship of PEDQ score with 24-hour SBP, 24-hour DBP, daytime SBP, daytime DBP, nighttime SBP and nighttime DBP was examined by including linear and quadratic terms of PEDQ score in linear models. To investigate the potential moderator effect of race on the relationship between PEDQ and ABP dipping status, in analysis limited to participants who self-identified as black Hispanic or white Hispanic, we created an unadjusted regression model that included the continuous PEDQ score, race and a PEDQ score\*race interaction term for Hispanics blacks vs. Hispanic whites. We then performed a stratified  $\chi^2$  analysis of the proportion of participants with abnormal ABP non-dipping according to Hispanic race. We performed exploratory analyses stratifying according to the sub-dimensions of racism explored in the brief-PEDQ. We conducted mediation analysis testing the ability of social support and depressive symptoms to mediate the relationship of perceived racism and ABP dipping. We also performed a moderation analysis for depression or social support on the PEDQ score – ABP relationship (PEDQ\*CESD term or PEDQ\*CSSS term with ABP night-day ratio as the outcome) Statistical significance was determined at the  $\alpha=0.05$  level using two-sided tests. All analyses were conducted using SAS 9.2 software (SAS Institute; Cary, NC).

## RESULTS

Fifty-nine percent of the participants were female; mean age of the cohort was  $67.1 \pm 8.7$  years (range = 50–94); mean BMI was  $27.7\text{kg/m}^2 \pm 3.9$ . Fifty-three percent were smokers. The cohort comprised of 78% Caribbean-Hispanics (mostly Dominicans), with the remaining sample from Mexico, and Central/South America. Ninety-three percent of the cohort was born outside of the US. Regarding race, 41.1% of the cohort self-identified as Hispanic-white and 34.4% as Hispanic black; 24.5% participants did not identify as either black or white Hispanic. The mean level of education was 9th grade, with an average annual income of \$5000 to \$15,999. Fifty-eight percent reported high levels of social support with relatively low levels of depressive symptoms. Fifty-four percent were ABP non-dippers. The mean 24-hour SBP was  $121.2\text{mmHg} \pm 11.6$ ; mean 24hr diastolic BP was  $71.6\text{mmHg} \pm 7.1$ .

### Correlates of perceived racism among Hispanics

The mean PEDQ score was of  $1.3 \pm 0.4$  with a median of 1.2. The relative frequency distribution of PEDQ scores showed that 77.8% of the cohort experienced *some* level of perceived discrimination (PEDQ score  $>1.0$ ). PEDQ score did not vary by sex or income:  $r = 0.03$ ,  $p = 0.66$ . Those who reported high perceived racism tended to be younger ( $r = -0.32$ ;  $p < 0.001$ ), more educated  $r = 0.17$ ,  $p = 0.02$  and tended to have smoked at some point during their lifetime. For those participants who self-identified as Hispanic-white or Hispanic-black, mean PEDQ scores did not vary by race (Hispanic whites  $1.26 \pm 0.31$  vs. Hispanic blacks  $1.31 \pm 0.34$ ;  $p = 0.43$ ). However, significantly more Hispanic whites were in the highest and lowest tertiles of PEDQ scores compared to Hispanic blacks ( $p = 0.04$ ). (Table 1) Greater social support ( $r = -0.54$ ;  $p < 0.001$ ) and less depressive symptoms ( $r = 0.25$ ;  $p < 0.001$ ) were significantly associated with lower PEDQ scores. (Figure 1) For each unit increase in PEDQ score, CSSS averaged 0.6 points lower ( $B = -0.57$ ,  $SE = 0.07$ ;  $p < .001$ ) in univariate analysis and 0.5 points lower ( $B = -0.54$ ,  $SE = 0.08$ ;  $p < .001$ ) in multivariate analysis adjusting for age, sex, BMI, and smoking status. For each unit increase in PEDQ score, CES-D score averaged 8.4 points higher ( $B = 8.39$ ,  $SE = 1.67$ ;  $p < .001$ ) in univariate analysis and 8.8 points higher ( $B = 8.78$ ,  $SE = 1.79$ ;  $p < .001$ ) in multivariate analysis.

### Perceived Racism and ABP

In unadjusted analysis, perceived racism trended inversely with ABP night-day ratio ( $B = -0.02$ ,  $SE = 0.012$ ;  $p = 0.07$ ) and nighttime SBP ( $B = -4.35$ ,  $SE = 2.41$ ;  $p = 0.07$ ). Mean PEDQ scores were significantly higher in dippers vs. non-dippers ( $1.40 \pm 0.5$  vs.  $1.25 \pm 0.3$ ;  $p = 0.01$ ). One unit increase in PEDQ scores was associated with a lower odds of ABP non-dipping; ( $OR = 0.37$ ,  $CI = 0.16 - 0.85$ ;  $p = 0.02$ ). This relation persisted in multivariate models ( $OR = 0.40$ ,  $CI = 0.17 - 0.98$ ;  $p = 0.045$ ). Sensitivity analyses with the inclusion of income, education, social support or depressive symptoms in separate models showed that perceived racism remained significantly associated with ABP dipping status ( $p < 0.05$ ). CES-D or CSSS scores were not significantly different according to ABP dipping status ( $p > 0.10$ ). Mediation analysis revealed that neither social support nor depressive symptoms was significantly associated with the outcome variable ABP night-day ratio ( $p > 0.10$ ). Furthermore, the link between perceived racism and ABP night-day ratio was not moderated by social support nor depressive symptoms as neither interaction term was statistically significant ( $p > 0.80$ ).

In evaluating the specific components of 24-hour ABP, we found no significant linear relation between daytime or nighttime systolic or diastolic ABP with PEDQ scores. (Table 2) However, prior observations suggest that the relationship between perceived discrimination and BP may be non-linear.<sup>36</sup> Thus, we tested for non-linear relations between 24-hour ABP components and PEDQ scores (as continuous measures) and found a curvilinear trend for daytime SBP (PEDQ score: linear term  $B=-17.0$  with  $SE=9.3$ ,  $p=0.07$  and quadratic term  $B=4.2$  with  $SE=2.5$ ,  $p=0.09$ ), (Figure 2) but not for other ABP measures (all  $p$ -values  $>0.1$ ). This indicates that daytime SBP is highest among those who reported the least and highest amounts of perceived discrimination. Further exploratory analysis did not show statistical significance when stratifying according to the sub-dimensions of racism with any of the 24-hour BP components (all  $p>0.20$ ). However, marginal trends were seen for workplace discrimination with ABP night-day-ratio ( $p=0.05$ ) and nighttime SBP ( $p=0.07$ ); physical threat with nighttime SBP ( $p=0.07$ ); and stigmatization with daytime DBP ( $p=0.05$ ) and 24-hour DBP ( $p=0.08$ ). (Table S1, Supplemental Digital Content 1).

### Racism, ABP and Race among Hispanics

Among those with low perceived racism, being black-Hispanic was associated with significantly more prevalent ABP non-dipping ( $N=21$ ; 83%) versus white Hispanics ( $N=19$ , 54%,  $\chi^2 = 5.2$ ,  $p=0.02$ ). Among Hispanics with high perceived racism, no differences between black versus white participants were found in prevalence of ABP non-dipping (black-Hispanic  $N=18$ , 62%; white Hispanic  $N=24$ , 51%,  $\chi^2 = 0.8$ ,  $p=0.38$ ) (Figure 3) However, the PEDQ by race interaction was not statistically significant for ABP night-day ratio ( $p=0.92$ ) or for dipping status ( $p=0.89$ ). However, when race was added to our multivariate models, perceived racism became non-significant ( $p=0.39$ ) whereas black race remained significantly predictive ( $p=0.02$ ) of ABP night-day ratio and ABP dipping status among Hispanics.

## DISCUSSION

Prior studies of perceived racism and ABP have mostly involved non-Hispanic blacks,<sup>3-9</sup> while Hispanics have remain largely understudied in this regard. Our findings reveal that ~78% of the participant population had experienced some form of perceived racial and/or ethnic discrimination. Previous reports on the prevalence of perceived discrimination among US Hispanics indicate that ~30–40% of the Hispanic population had experienced some form of racism.<sup>37, 38</sup> Similar findings were published in the Boston Puerto Rican Health Study, where 37% of Puerto Ricans reported some incidence of perceived racism or discrimination.<sup>39</sup> The high occurrence of perceived discrimination in our cohort of Hispanics approached that commonly observed for non-Hispanic blacks.<sup>40, 41</sup> This may be due to the predominant Hispanic subgroup of Dominicans in our cohort, their predominant immigrant status, or the urban setting. Nevertheless, these data signify that perceived racism is relatively important to Hispanics and that discriminatory experiences are prevalent in the Hispanic consciousness.

## Determinants of Perceived Racism among Hispanics

We report that perceived discriminatory experiences were highest among younger individuals. This finding is similar to Boston Puerto Rican Health Study, in which perceived racism experiences were more likely in the younger versus older Hispanics.<sup>39</sup> The higher incidence of perceived discrimination experiences in ‘younger’ Hispanic individuals may be ascribed to the notion that younger Hispanics are more likely to acculturate faster.<sup>42</sup> Hispanics who are more acculturated with a better understanding of the US culture and lifestyle and/or increased English fluency may better understand and interpret discriminatory actions, being more perceptive of subtle dimensions of discrimination.<sup>37</sup> Moreover, people with advanced age are less likely to leave their cultural niche or home environment, due to functional or language limitations thus are also less likely to face the prejudices of the mainstream society.<sup>43, 44</sup>

We demonstrate for the first time that individuals who self-identified as black Hispanic experienced greater levels of discrimination than those who self-identified as white Hispanic. These findings may reflect the perceptions of the discriminator, thereby associating blacks Hispanic with non-Hispanic blacks. Prior studies report significantly greater discriminatory experiences in the non-Hispanic participants compared to their Hispanic counterparts.<sup>45–48</sup> However, none of these studies identified which Hispanic subgroup they were studying or the race of their Hispanic participants. It has been postulated that Hispanics with darker skin color may experience discrimination at higher rates than other Hispanics.<sup>39</sup> Thus, with regard to perceived racism, black Hispanics may have commonalities with their non-Hispanic counterparts that have previously been underappreciated.

## Nocturnal Blood Pressure Dipping and Perceived Discrimination

We note that ABP night-day ratio is inversely associated with perceived racism and that the relationship may be influenced by race in this cohort of Hispanics. White Hispanics demonstrated a lower prevalence of ABP non-dipping that was not influenced by levels of perceived discrimination; whereas, only black Hispanics with the lowest levels of perceived racism had the highest prevalence of ABP non-dipping in the cohort. Black Hispanics did not have higher levels of racism than white Hispanics. In fact, black Hispanics were less likely to be in either extreme racism encounters (the lowest or highest tertile of PEDQ scores) compared to white Hispanics but were more likely to be affected (with regards to ABP) by racism encounters. Thus, we feel that black Hispanics may experience racism differently than white Hispanics.

Furthermore, daytime SBP demonstrated a trend towards a more curvilinear relationship with PEDQ scores. Individuals who reported some discrimination had lower daytime SBPs than those who reported no discrimination, and those reporting a substantial amount of discrimination had higher SBPs than both those who reported no or some discrimination. Thus, although lower nighttime SBPs were more prevalent among individuals with higher PEDQ scores, this is confounded by the fact that higher levels of perceived discrimination did appear to increase daytime SBPs. This trend suggests that increased perceived racism may in fact affect daytime vs. nighttime SBPs differently depending on the number of



perceived racism experiences. Nighttime SBP did not appear to be as significantly affected across PEDQ scores; however, higher levels of perceived discrimination did appear to increase daytime SBPs. These results are unexpected. It is important to note that virtually all of the prior studies on perceived racism and ABP have been done on non-Hispanic blacks. Ours is the first dedicated sample of Hispanics to study this relationship. It is important to understand whether the same effects of racism on ABP are seen in non-Hispanic blacks are also present among Hispanics, because there is some evidence that Hispanics (or at least some Hispanic groups) do not necessarily show the same patterns of cardiovascular health as would be expected based on their SES and other health risk factors.<sup>16, 17</sup> This is the so-called ‘Hispanic Paradox.’<sup>49</sup> Hispanics are suspected to have different psychosocial-cultural characteristics such as familial resiliency and social support which may set them apart from non-Hispanic blacks and whites.<sup>49</sup> The higher prevalence of non-dipping in black-Hispanics who score low on perceived discrimination is not consistent with the purported elevated cardiovascular risk associated with perceived discrimination. This may in part be relevant to the Hispanic paradox. Although speculative, our results may have to do with coping mechanisms (such as less rumination or internalization) or stress-buffering experiences among this Hispanic cohort; such that their daytime perceived racism experiences do not affect them during sleep. Coping mechanisms for social discrimination (internalization; John Henryism) have been well-studied in non-Hispanic blacks<sup>50</sup> but may deserve more consideration among black Hispanics as well.

Our findings document a curvilinear trend in the relation of average daytime SBP and PEDQ scores. This curvilinear relationship has been observed in prior studies<sup>36, 40</sup> and supports the notion that internalization of racism may exist among those with low PEDQ scores resulting in elevated daytime BP where some blame themselves for the negative personal maltreatment they receive<sup>50</sup> and thus do not perceive the interaction as discrimination per se. In contrast, although speculative, Hispanics with higher PEDQ scores may be more proactive against discrimination and possibly less likely to internalize the associated stress. These issues remain to be further studied.

### **Perceived Discrimination, Social Support, and Depression**

Our study is one of the first to report that low social support is associated with higher levels of perceived racism. This relation may be attributed to the “*buffering hypothesis*” of social support.<sup>51</sup> In this speculative scenario, high levels of social support “*buffer*” the extent of stress experienced when facing discrimination thus affecting the outcome of ABP. Hence, individuals with high levels of social support who encounter discriminatory stress can readily recollect and/or identify positive avenues and coping mechanisms in response. Alternatively, high levels of social support among Hispanics may alter the individual’s *perception* of the threat posed by interpersonal maltreatment or discriminatory stress. Although our analysis did not reveal that the relation of perceived racism and ABP was moderated by social support, we were likely underpowered to detect such an interaction. These phenomena deserve to be further elucidated in future larger studies.

We report an association of increasing depressive symptoms with higher rates of perceived discrimination. Perceived discrimination has been linked to increased depressive symptoms

among non-Hispanic black youth<sup>52</sup> and in a sample of Puerto Ricans.<sup>39</sup> Our study was cross-sectional, so we cannot determine whether higher levels of perceived discrimination led to increased depressive symptoms or whether increased depressive symptoms somehow influenced the perception of the interpersonal interaction in a way that resulted in higher PEDQ scores. Perceived discrimination and depression may work together in a vicious cycle that will require further study, particularly among Hispanics.

## Strengths and Limitations

Our study has several strengths. We utilized standard and validated assessments of ABP monitoring including the use of participant diary reports of sleep onset and waking times rather than arbitrary fixed-time intervals. This approach more accurately assesses ABP during sleep since waking times can vary considerably between participants. Although comprised of only 180 participants, the current study is still the largest study of perceived discrimination and diurnal BP assessment in a Hispanic population. This is important because there is less published information regarding ABP dipping and other cardiovascular risk factors in this population. Several limitations must be noted. First, our findings may not be generalizable to all Hispanics; our study includes mostly Caribbean-Hispanics, who represent only one sub-fraction of the Hispanic population.<sup>53</sup> Second, our assessment of race and ethnicity was through self-designation, which carries its limitations.<sup>54, 55</sup> This may be more problematic among Hispanics, where as a racially admixed population, the US concept of 'race' focusing only a white/black dimension may be confusing to Hispanics.<sup>56</sup> The majority participants who did not identify as black or white Hispanic either provided no response or felt that Hispanic ethnicity sufficiently equated to race. We therefore spent considerable time with each participant explaining what was meant when we asked them to self-identify race. In addition, the vast majority of participants in this study were foreign born. First- and second-generation US Hispanics may have differences in their response to or acknowledgement of discriminatory stress. We did not address dietary factors or sleep quality; however, the significance of these factors on ABP dipping is not clear.<sup>57, 58</sup> Because of the limited number of participants in the Hispanic race groups, our study was underpowered to detect statistically significant small-to-moderate formal interactions. Using mean PEDQ scores in those with normal versus abnormal ABP and a two-sided type-I error of 0.05, the current sample had less than 64% power for within-strata analysis to detect a formal statistical interaction. Nevertheless, on stratified analysis, Hispanic blacks were at a significantly higher prevalence of abnormal ABP non-dipping, compared to Hispanic whites. There are biologically plausible and clinically significant explanations for stratifying Hispanic black and Hispanic whites given what is known about non-Hispanic black and ABP dipping.<sup>12</sup> We have previously shown that Hispanic black and Hispanic whites may have more similarities in regards to ABP non-dipping to their non-Hispanic counterparts.<sup>59</sup> Our study did not include an evaluation or measure of anger, a common response to discriminatory experiences, at least among non-Hispanic populations. Finally, our study was cross-sectional, which precludes any conclusions about causality.

## Perspectives

It is important to note that virtually all of the prior studies on ABP dipping have been done on non-Hispanic blacks and whites. Ours is the first dedicated sample of Hispanics to study

perceived racism and ABP. Our study reveals that an important association of perceived racism with ABP exists in a Hispanic cohort and emphasizes the value of perceived discrimination as an important concept among Hispanics. We document for the first time the association of race with perceived discrimination and ABP among Hispanics. Future studies in Hispanics should consider the role of race. Further work is needed to identify the factors affecting racial identification among Hispanics and how race shapes societal interactions among Hispanics in the US. Our findings also provide strong rationale for future studies to identify whether different coping mechanisms exist among Hispanics with regards to perceived discrimination and whether the role of social support can be maximized among vulnerable populations to combat the negative health effects of perceived discrimination.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Abbreviations

<b>ABP</b>	Ambulatory Blood Pressure
<b>BP</b>	Blood Pressure
<b>OR</b>	Odds Ratio
<b>CI</b>	Confidence Interval
<b>US</b>	United States
<b>NOMAS</b>	Northern Manhattan Study
<b>SD</b>	Standard Deviation
<b>PEDQCV</b>	Perceived Ethnic Discrimination Questionnaire Community Version
<b>SE</b>	standard error
<b>BMI</b>	Body Mass Index
<b>SBP</b>	systolic blood pressure
<b>DBP</b>	diastolic blood pressure

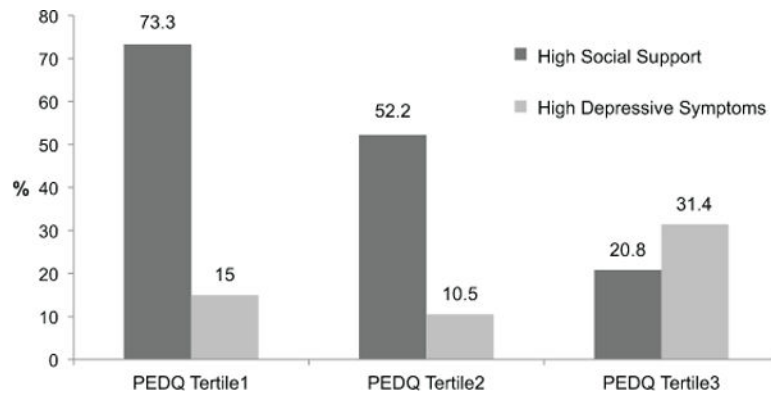
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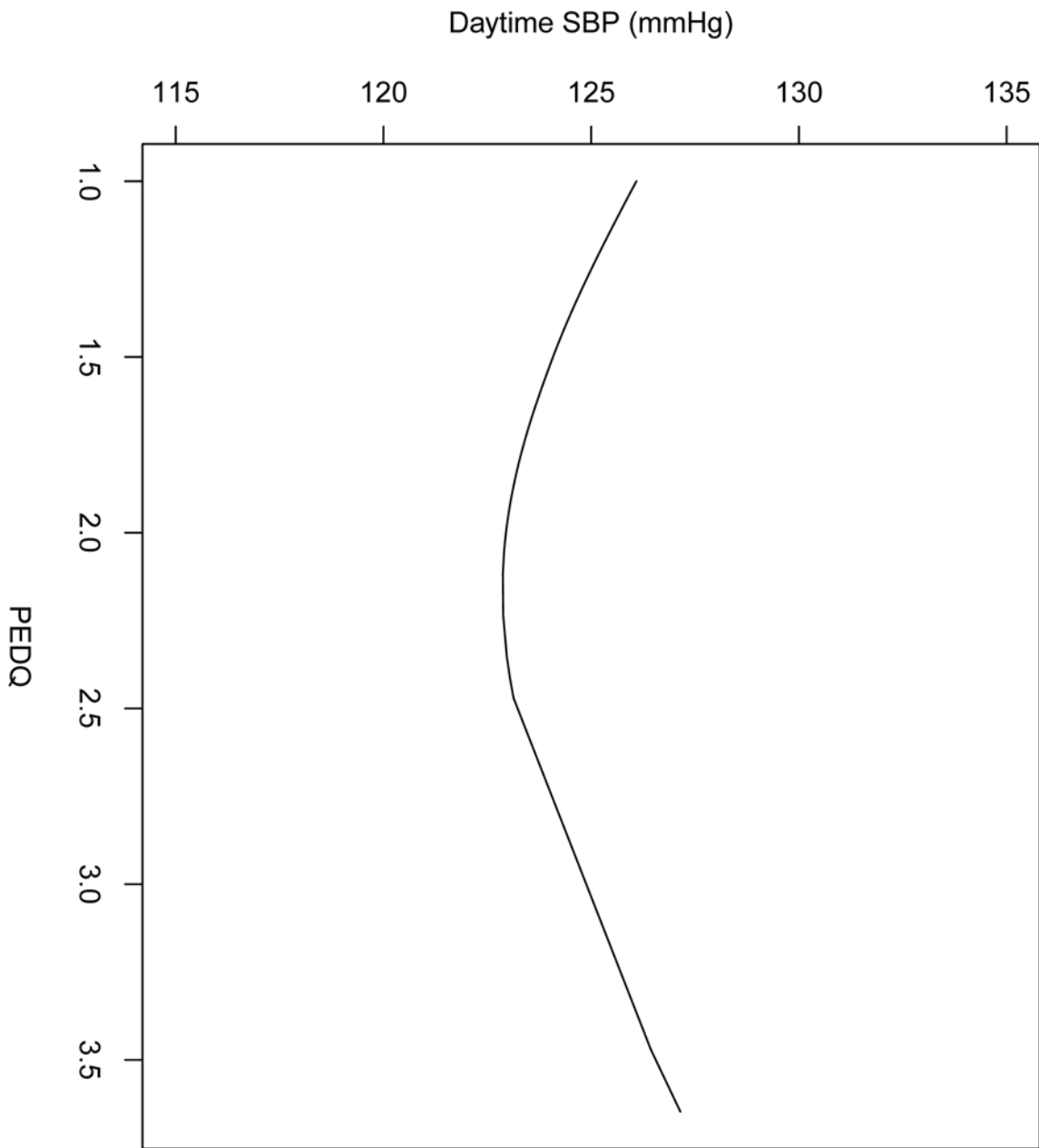


**Figure 1.** Prevalence of participants with high levels of reported social support and high levels of reported depressive symptoms according to PEDQ score tertile.

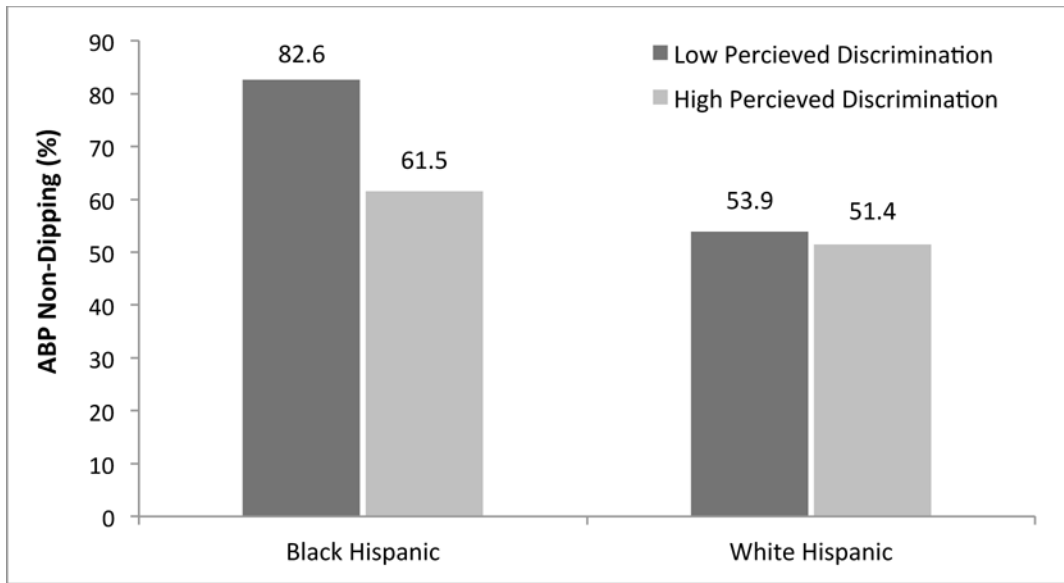
PEDQ, Perceived Ethnic Discrimination Questionnaire

The prevalence of perceived racism/discrimination depends on social support and depressive symptoms. The proportion of those with high levels of depressive symptoms more than doubles when going from the lowest to the highest PEDQ score tertile. The proportion of those with high levels of social support was almost three times greater in the lowest vs. the highest PEDQ score tertile.





**Figure 2.** Association of Mean 24-hour Ambulatory Daytime SBP and perceived discrimination  
This Figure is generated with cubic splines using smoothing parameter selected by generalized cross-validation method to show the non-linear trend of mean daytime BP by PEDQ score.  
SBP, systolic blood pressure  
PEDQ, Perceived Ethnic Discrimination Questionnaire



**Figure 3.** ABP Dipping status by race and level of Perceived Discrimination. Among black Hispanic participants, having high Perceived Discrimination levels was associated with more prevalent ABP non-dipping compared to having low Perceived Discrimination levels. All white Hispanics regardless of Perceived Discrimination levels had a lower prevalence of ABP non-dipping compared to black Hispanics.

**Table 1**

Characteristics of Subjects According to PEDQ Score

Characteristic	Total Sample	PEDQ Tertile1 n=60	PEDQ Tertile2 n=67	PEDQ Tertile3 n=53	P value
Age (years)	67.1±8.7	69.5±8.2	67.7±9.5	63.7±7.2	0.001
Females/Males (%)	58.9/41.1	51.7/48.3	67.2/32.8	56.6/43.4	0.19
Ever Smoked (%)	52.8%	45.0	46.3	69.8	0.012
Hispanic Race (%) <sup>*</sup>					0.037
White	41.1%	63.0	40.0	62.5	
Black	34.4%	37.0	60.0	37.5	
BMI (kg/m <sup>2</sup> )	27.7±3.9	27.5±3.6	27.3±4.1	28.4±3.9	0.24
CSSS score	2.9±0.4	3.1±0.4	2.9±0.4	2.6±0.4	<0.001
Education (years)	9.4±4.4	8.8±4.7	9.3±4.4	10.3±4.0	0.18
Income Category	2.4±1.0	2.4±1.3	2.3±0.9	2.3±0.9	0.92
CES-D score	7.8±9.6	6.1±8.4	5.9±6.9	12.4±12.2	<0.001

BMI, Body Mass Index; CSSS, CARDIA Study Social Support Scale

CES-D, Center for Epidemiological Studies Depression scale

<sup>\*</sup> Limited to participants who self-identified as black Hispanic or white Hispanic.

**Table 2**

24-hour Blood Pressure Components according to PEDQ score

Characteristic	Total Sample	PEDQ Tertile1 n=60	PEDQ Tertile2 n=67	PEDQ Tertile3 n=53	P value
24-hour SBP (mmHg)	121.2±11.6	122.2±10.5	120.9±13.0	120.3±11.2	0.68
24-hour DBP (mmHg)	71.5±7.1	71.2±6.6	71.9±7.1	71.5±7.6	0.86
ABP NIGHT-DAY ratio	0.9±0.07	0.9±0.1	0.9±0.1	0.9±0.1	0.36
24-hour nighttime SBP	114.0±13.1	115.7	114.1	112.0	0.33
24-hour daytime SBP	125.1±11.9	126.1	124.7	124.4	0.73
24-hour nighttime DBP	65.7±7.4	66.2	66.1	64.9	0.62
24-hour daytime DBP	74.6±7.6	74.2	75.0	74.7	0.82
Non-Dippers (%)	57.8	65.0	62.7	43.4	0.040
<b>*24-hour SBP Category (%)</b>					0.031
Normotensive	46.7	40.0	55.2	43.4	
Pre-Hypertensive	46.7	56.7	32.8	52.8	
Hypertensive	6.7	3.3	11.9	3.8	

SBP, systolic blood pressure; DBP, diastolic blood pressure; ABP, ambulatory blood pressure

\* based on average 24-hour SBP