



Perceived Discrimination and Cardiometabolic Risk Among US Hispanics/Latinos in the HCHS/SOL Sociocultural Ancillary Study

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Abstract

Background Metabolic syndrome (MetS) is a group of cardiovascular risk factors including elevated blood pressure, elevated triglycerides, decreased high-density lipoprotein cholesterol, impaired fasting glucose, and abdominal obesity, which disproportionately affects Hispanics/Latinos. The present study examined associations between perceived discrimination and MetS in Hispanic/Latino adults from various background groups (i.e., Dominican, Central American, Cuban, Mexican, Puerto Rican, South American).

Methods Data were obtained from 5174 Hispanics/Latinos who participated in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) Sociocultural Ancillary Study. MetS components and covariates were measured at a baseline examination, and perceived discrimination was assessed within 9 months of baseline. Path analysis modeled associations of perceived discrimination with MetS prevalence and each of the six components of MetS, controlling for age, sex, income, acculturation, physical activity, diet, smoking, and alcohol use.

Results Among the full cohort, perceived discrimination was not associated with MetS prevalence in any of the models evaluated. Higher perceived discrimination at work/school was associated with larger waist circumference. When examining background groups separately, higher perceived ethnicity-associated threat was related to increased MetS prevalence only among individuals of Central American background. Differential patterns of association between perceived discrimination and MetS components were found for different background groups.

Conclusions Overall results suggested that perceived discrimination was not strongly or consistently associated with MetS among Hispanics/Latinos.

Keywords Hispanic/Latino · Perceived discrimination · Metabolic syndrome · Cardiometabolic risk · Path analysis · Background groups

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Introduction

The metabolic syndrome (MetS) refers to a group of frequently comorbid cardiovascular risk factors that includes elevated blood pressure (BP), elevated triglycerides, decreased high-density lipoprotein cholesterol (HDL), elevated fasting glucose, and abdominal obesity [1]. Though MetS impacts individuals of varied ethnic/racial backgrounds, Hispanics/Latinos are disproportionately affected, and have the highest rates of MetS in the USA [2]. Within the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), a population-based cohort study of 16,415 diverse Hispanic/Latino adults living in the USA, the age-standardized prevalence of MetS was 33.7% among men and 36.0% among women, with rates significantly varying across background groups [3]. Furthermore, compared with non-Hispanic whites and non-Hispanic blacks, Hispanics/Latinos have higher rates of select MetS components, such as elevated triglycerides and decreased HDL cholesterol [4]. Given that the Hispanic/Latino population in the USA is rapidly increasing and is expected to constitute more than one quarter of the total US population by 2050 [5], a better understanding of the correlates and drivers of disease within this population is an imperative national public health goal.

In addition to traditional medical risk factors for MetS, psychological and sociocultural variables may also have implications [6]. One concept that may be particularly relevant for Hispanics/Latinos is perceived discrimination. Negative ethnicity-related interpersonal interactions have generally been associated with myriad adverse physical and psychosocial outcomes [7]. The Reserve Capacity Model [8] provides one theoretical framework to better understand these relationships. This model posits that individuals with “low social status,” such as those of minority ethnicity, have fewer positive and uplifting experiences as well as more frequent and severe stressful experiences. This can in turn influence health outcomes directly through behavioral (e.g., diet, physical activity) and physiological (e.g., immunological) processes, or indirectly as mediated by psychosocial variables (e.g., positive and negative affect). Minority status may also contribute to increased vulnerability to stress due to insufficient resilience-promoting resources (e.g., tangible factors such as transportation, interpersonal factors such as social support, or intrapersonal factors such as intrinsic locus of control), and minimal opportunity to replenish such resources when they are used. That is to say that individuals with low social status may have diminished *reserve capacity* to cope with stress. Thus, corresponding to this model, Hispanic/Latino individuals may encounter increased stressful experiences, which could in turn contribute to increased rates of MetS indirectly via psychosocial variables that may be related to increased prevalence of MetS (e.g., perceived discrimination). In accordance with this model, a study conducted with 145 middle-aged Latina women recruited from health clinics along the California-Mexico border

with low social status, operationalized as low socioeconomic status (SES), found that women with lower SES demonstrated higher systolic ($\beta = -0.23$) and diastolic ($\beta = -0.19$) BP, waist circumference ($\beta = -0.29$), and plasma glucose ($\beta = -0.19$; all $ps < 0.05$) [9]. A relationship between SES and waist circumference, via psychosocial resources as an indirect pathway ($\beta = -0.09$, $p < 0.05$) was also found. In a separate study conducted with HCHS/SOL participants, a relationship between SES and a latent factor reflecting glucose regulation and abdominal obesity was found, again via psychosocial resources and risk [10]. This study found that higher SES was significantly associated with greater psychosocial resources and less psychosocial risk ($\beta = -0.60$, $p < 0.001$), which in turn was associated with improved glucose regulation and less abdominal obesity ($\beta = -0.14$, $p < 0.001$). Other studies conducted with ethnically diverse study samples have demonstrated that culture-related stressors such as perceived discrimination are associated with worse diabetes management and glucose control [11] and adverse cardiovascular disease outcomes [12]. For example, in their analysis of African Americans, black immigrants, and Hispanic/Latino immigrants in New Hampshire, Ryan and colleagues [13] found perceived discrimination to be quadratically related to systolic BP ($b = 2.18$, $SE = 0.77$, $p < 0.001$); in that, those reporting no perceived discrimination or high levels of perceived discrimination had higher BP than those reporting low levels of perceived discrimination. Similarly, analysis of the Multi-Ethnic Study of Atherosclerosis (MESA) also found that more exposure to lifetime discrimination was associated with increased CVD risk across racial/ethnic groups ($HR = 1.36$) [14]. However, although there is evidence generally supporting these relationships, they have not been explored specifically among Hispanics/Latinos at the population level.

A great deal of research has evaluated Hispanic/Latino health outcomes. However, much of this research has considered Hispanics/Latinos as a monolithic group, precluding exploration of potentially important differences among distinct Hispanic/Latino background groups in the USA. Data provided by HCHS/SOL participants have demonstrated differing rates for MetS within different Hispanic/Latino background groups [3], in addition to related conditions including type 2 diabetes [3] and cardiovascular diseases [15]. Differing rates of MetS have also been found across Hispanics/Latinos in Latin American countries, with higher rates documented in Mexico and Central America than South America [16, 17]. Similarly, differences in related health behaviors, such as smoking, drug use, and leisure-time physical activity, have been observed across Hispanic/Latino background groups in the USA [18–20]. In the HCHS/SOL sample, Cubans have demonstrated higher intakes of total energy, macronutrients, and alcohol as compared to individuals of other backgrounds [21]. Moreover, smoking rates have been shown to be higher among Puerto Ricans and Cubans, and particularly low among Dominicans, as compared to other Hispanic/Latino

background groups [22]. Differences also exist for reports of healthcare-related experiences, including perceived discrimination in quality of healthcare received [23]. A separate analysis of HCHS/SOL participants demonstrated differences in lifetime perceived ethnic discrimination across background groups, predominantly due to variability in education, income, and acculturation, and influence from historical immigration patterns [24]. Individuals from different Hispanic/Latino background groups may immigrate to the USA for different reasons, which can contribute to different types and levels of stress. This can mitigate in part the impact of acculturative stress, which in turn may contribute to decreased engagement in adverse health behaviors [25]. For example, analysis of the Hispanic American Baseline Alcohol Survey (HABLAS) suggested that there is a heterogeneous effect of acculturation stress on drinking behavior across Hispanic/Latino background groups [26]. However, more research is needed to better understand how culture-related stressors may impact each Hispanic/Latino subgroup separately.

The present investigation aimed to address these gaps and evaluate whether perceived discrimination is associated with the prevalence and components of MetS in distinct Hispanic/Latino background groups. It was hypothesized that (1) perceived discrimination would be significantly associated with MetS prevalence and levels of MetS components and (2) relationships of perceived discrimination to MetS prevalence and MetS components would vary when evaluated within different Hispanic/Latino background groups (i.e., Central American, Cuban, Dominican, Mexican, Puerto Rican, and South American).

Methods

HCHS/SOL

The HCHS/SOL is a prospective, population-based study of multiple health conditions and their risk factors among 16,415 diverse Hispanics/Latinos ages 18–74 residing in four US metropolitan areas [27]. The four recruitment sites for the HCHS/SOL represent four of the ten largest Hispanic/Latino urban metropolitan areas in the USA: Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA. Participants self-identified as Central American, Cuban, Dominican, Mexican, Puerto Rican, or South American. A stratified two-stage area probability sample of household addresses was conducted at each field center. Stratification was based on concentration of Hispanic/Latino households, and low versus high SES (as measured by the proportion of persons with at least a high school education), each based on the 2000 decennial Census. Participants aged 45–74 years were over-sampled. Once a household was selected, all eligible household members were invited to participate. Persons who met the

eligibility criteria and agreed to participate were scheduled for an Institutional Review Board (IRB)-approved consenting and assessment appointment. Informed consent was obtained from all individual participants included in the study.

Of the 7321 participants who completed the baseline interview and were invited to participate in the subsequent HCHS/SOL Sociocultural Ancillary Study, 73% elected to do so. These Sociocultural Ancillary Study participants provided informed consent and completed the sociocultural assessment within 9 months of their initial HCHS/SOL baseline interview, and the majority did so within 4 months. The Sociocultural Ancillary Study examined the role of SES, sociocultural, and psychological risk and protective factors as they relate to MetS and cardiovascular disease. The Sociocultural Ancillary sample consisted of 5313 participants, and was found to be representative of the larger HCHS/SOL sample with the exception of lower participation rates at some higher SES levels [28]. The study followed ethical standards for human research and was approved by the IRB of each of the four field centers. Complete details regarding the design and procedures of the HCHS/SOL [27, 29] and the Sociocultural Ancillary Study [28], including processes for translating study measures, have been previously reported.

Study Measures

Primary Outcomes The primary outcomes were MetS prevalence and the components of MetS as defined by the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) [30]: HDL cholesterol, triglycerides, glucose, waist circumference, systolic BP, and diastolic BP. Participants were classified as meeting criteria for MetS if three or more of the following risk factors were present: (1) waist circumference ≥ 102 cm in men or ≥ 88 cm in women, (2) triglyceride level ≥ 150 mg/dL, (3) HDL cholesterol < 40 mg/dL in men or < 50 mg/dL in women, (4) systolic BP ≥ 130 or diastolic BP ≥ 85 or participant was taking anti-hypertension medications, and (5) fasting glucose ≥ 100 mg/dL or participant was taking anti-diabetic medications. Fasting blood draws were used to assay HDL, triglycerides, and glucose levels, and all tests were performed at a central lab. Resting BP was measured with an oscillometric automated sphygmomanometer after participants rested 5 min in a seated position. Systolic and diastolic BP were measured three times, each 1 min apart, and averaged. Waist circumference was measured at the highest lateral border of the right ilium. See Heiss et al. [3] for a more comprehensive description of how components of MetS were measured. In all analyses MetS prevalence was evaluated as a dichotomous categorical variable, and MetS components were evaluated as continuous variables.

Primary Explanatory Variables The primary explanatory variables were perceived discrimination, assessed via the Perceived Ethnic Discrimination Questionnaire Community Version–Brief (Brief PEDQ-CV) [31]. The Brief PEDQ-CV consists of 17 items and has four subscales: Exclusion/Rejection, Stigmatization/Disvaluation, Work/School Discrimination, and Threat/Aggression. Higher scores indicate greater perceived discrimination. The Brief PEDQ-CV was developed as a psychometrically sound alternative to the longer PEDQ and PEDQ-CV instruments to assess the experience of discrimination among community-dwelling adults [31, 32]. Confirmatory factor analyses (CFA) have shown adequate structural validity for total and subscale scores, and factorial invariance across the Spanish and English versions of the measure [24]. In the current sample, internal consistency and reliability was adequate to good for the Brief PEDQ-CV scales among individuals who participated in English (total score: $\alpha = 0.91$, subscale scores: α s ranged from 0.78 to 0.82) and among those who participated in Spanish (total score: $\alpha = 0.87$, subscale scores: α s ranged from 0.69 to 0.76).

Covariates Primary analyses controlled for age, sex, Hispanic/Latino background group, income, acculturation, physical activity, diet, smoking, and alcohol use, as these variables have previously been shown to be associated with MetS. Participant age, sex, income (<\$10,000, \$10,001–\$20,000, \$20,001–\$40,000, \$40,001–\$75,000, >\$75,000), and Hispanic/Latino background group were self-reported. Acculturation was assessed using the Short Acculturation Scale for Hispanics (SASH) [33]. SASH language and ethnic social relations scores showed adequate reliability in the study sample (language: English $\alpha = 0.80$, Spanish $\alpha = 0.85$; ethnic social relations: English $\alpha = 0.65$, Spanish $\alpha = 0.71$). Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ) [34] to quantify the self-reported number of minutes of moderate or vigorous activity per day. This information was used to estimate a total metabolic equivalent task for each participant [15], with higher scores representing more physical activity. Diet quality was captured with the 2010 Alternative Healthy Eating Index (AHEI), a composite score of diet quality based on foods and nutrients predictive of chronic disease risk [35]. The AHEI score was calculated from data obtained in two 24-h dietary recalls, and higher scores represented better diet. Smoking was reported as current, former, or minimal (i.e., fewer than 100 lifetime cigarettes) [15]. Participants were asked about current and past alcohol consumption, as well as the total number of drinks consumed per week at the time of study completion. Based on this information alcohol use was categorized as low risk, high risk, or non-drinker based on guidelines from the National Institute for Alcohol Abuse and Alcoholism [36]. Outcome and covariate data were collected at the HCHS/SOL baseline interview. Brief PEDQ-CV data were collected at the Sociocultural Ancillary Study interview.

Analyses

Data presented in the form of frequencies are unweighted. Data presented in the form of percentages and means are weighted to account for the sampling design and adjust for bias due to differential nonresponse in the selected sample at the household and person levels. The weights were trimmed to limit precision losses due to their variability, and calibrated to the 2010 Census characteristics by age, sex, and Hispanic/Latino background group within each field site's target population. All analyses also accounted for cluster sampling and the use of stratification in sample selection, as standardized across all HCHS/SOL analyses. See LaVange et al. [29] for more detail regarding how analyses account for the HCHS/SOL sample design.

Path analysis was used to simultaneously model the relationship of perceived discrimination with MetS prevalence and each of the six components of MetS. Models were evaluated both unadjusted and after controlling for age, sex, income, acculturation, physical activity, diet, smoking, and alcohol use. Unlike traditional multiple regression, path analysis enables testing of multiple dependent variables within a single model, yielding a more efficient measurement approach [37]. Separate models were created for total and subscale scores of the Brief PEDQ-CV to enable a more nuanced evaluation of how perceived discrimination relates to MetS prevalence and components. Each model was initially run on the full cohort, and then run separately for each Hispanic/Latino background group to enable examination of these relationships within each Hispanic/Latino background group in isolation. The model evaluating the full cohort also controlled for Hispanic/Latino background group. To facilitate interpretation, standardized regression coefficients (β) are reported, so that the unit of measurement is one standard deviation.

In addition to paths for covariates and perceived discrimination to components of MetS, residuals of MetS prevalence and components of MetS were freely correlated to allow for associations not due to perceived discrimination or the covariates, resulting in a saturated model. Though this did not impact interpretation of the path coefficients demonstrating the relationships between perceived discrimination and MetS, in a saturated model the model will perfectly fit the data. Model fit indices are therefore not reported. Figure 1 shows the structure of the path analyses used in this study.

Components of MetS were assessed for normality. Triglycerides and glucose were non-normally distributed, and were therefore natural log transformed prior to analysis. Data were analyzed using R v.3.2.1 [38] and Mplus v.7.2 [39] via MplusAutomation v.0.6–3 [40]. Survey weights, strata, and clusters were included in the models so that estimates were weighted to the population, and standard errors appropriately adjusted for the sampling design [41]. Full information maximum likelihood (FIML) was used to address missing data, as it is more efficient than listwise deletion, performs

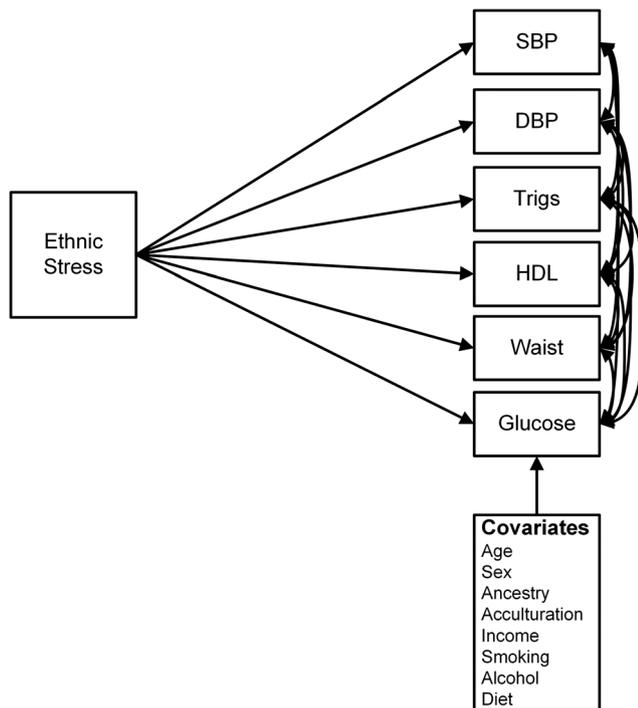


Fig. 1 Conceptual diagram of models tested. Ethnic stress variables were tested one at a time and included Brief PEDQ-CV total and subscale scores. This model was initially run on the full cohort, and then run separately for each Hispanic/Latino background group. Only the model evaluating the entire sample also controlled for Hispanic/Latino ancestry

favorably compared to multiple imputation, and produces unbiased parameter estimates and standard errors under various missing data conditions [42]. This approach allows cases with missing data on one or more study variables to be included in analyses, as long as they have partial data available. The robust maximum likelihood estimator was used to provide model fit and standard errors robust to non-normality.

To address issues of site and Hispanic/Latino background group confounding, models were tested with and without recruitment site as a covariate. Model results were evaluated for substantive differences in standard estimates, which might indicate a substantial site effect. The a priori criteria used to identify a site effect were a change in significance at the $p < 0.05$ level or a change in standard error ≥ 0.01 . Adjusting for site did not substantially change results according to these criteria; thus, results are reported from models that do not adjust for site.

Results

Participant Characteristics

Data from 5174 Sociocultural Ancillary Study participants were used in this analysis. To compare findings across different Hispanic/Latino background groups, data from 139 participants who self-reported more than one background or “other”

were excluded. Table 1 shows estimated demographic characteristics and average values of MetS components and covariates for the study sample. The majority of participants were female (55%) and elected to participate in Spanish (77%), with 44% of the sample above the age of 45 (mean (M) = 42.79, 95% confidence interval (CI) = 42.1–43.5). Approximately half of the sample (52%) had a self-reported annual household income \leq \$20,000. SASH scores indicated a low mean level of acculturation to the USA (language: M = 2.06, 95% CI = 1.99–2.13; social: M = 2.22, 95% CI = 2.18–2.25). One-third (n = 1975) of the sample met NCEP ATP III guidelines for MetS [28].

Perceived Discrimination as a Predictor of Metabolic Syndrome Prevalence

Results of the unadjusted and adjusted associations of Brief PEDQ-CV scores with MetS prevalence can be found in Tables 2, 3, 4, 5, and 6. Perceived discrimination was not significantly associated with MetS prevalence when all Hispanic/Latino groups were evaluated in aggregate. Among individuals of Central American background, higher scores on the Brief PEDQ-CV Threat/Aggression subscale were associated with increased likelihood of meeting criteria for MetS both before (β = 0.14, 0.02–0.25 95% CI) and after adjusting for covariates (β = 0.17, 0.06–0.29 95% CI). No significant associations were found between Brief PEDQ-CV total or subscale scores and MetS prevalence among any other Hispanic/Latino background groups.

Perceived Discrimination as a Predictor of Metabolic Syndrome Components

Results of the unadjusted and adjusted associations of Brief PEDQ-CV scores with levels of MetS components can be found in Tables 2, 3, 4, 5, and 6. When all Hispanic/Latino background groups were examined as an aggregate sample, the Brief PEDQ-CV total score was not associated with MetS components. Among the subscales, higher Work/School Discrimination scores were associated with a larger waist circumference (β = 0.04, 0.00–0.07 95% CI).

Among individuals of Cuban background, higher total scores on the Brief PEDQ-CV and higher scores on each of the four subscales were associated with higher diastolic BP (Total β = 0.13, 0.06–0.20 95% CI; Exclusion/Rejection β = 0.12, 0.05–0.20 95% CI; Stigmatization/Disvaluation β = 0.09, 0.02–0.16 95% CI; Work/School Discrimination β = 0.07, 0.00–0.14 95% CI; Threat/Aggression β = 0.10, 0.03–0.17 95% CI). In addition, higher Brief PEDQ-CV total scores were associated with slightly lower glucose levels (β = -0.06 , -0.13 – 0.00 95% CI). Higher Threat/Aggression scores were also associated with lower glucose levels (β = -0.08 , -0.13 – -0.02 95% CI), and higher Exclusion/Rejection scores were associated with higher

Table 1 (continued)

	Overall (n = 5174)	Dominican (n = 534)	Central American (n = 553)	Cuban (n = 775)	Mexican (n = 2080)	Puerto Rican (n = 880)	South American (n = 352)
Fasting glucose (mg/dL)	100.9, 31.9, 99.8–102.0	96.1, 25.6, 93.3–98.9	99.5, 27.6, 97.3–101.7	102.1, 31.7, 99.7–104.6	100.7, 33.3, 98.7–102.7	104.1, 35.5, 101.6–106.6	99.8, 27.4, 96.8–102.8
PEDQ-CV-B (range)							
Total (17–85)	25, 8.5, 24.6–25.4	23.8, 7.8, 23–24.6	25.1, 8.1, 24.3–26	22.7, 6.6, 22.2–23.3	25.8, 8.9, 25.1–26.5	26.7, 9.6, 25.8–27.6	25.2, 9.1, 24–26.4
Exclusion (4–20)	7.4, 3.2, 7.2–7.5	7, 3.1, 6.6–7.4	7.6, 3.2, 7.3–8	6.8, 2.9, 6.5–7	7.6, 3.2, 7.4–7.8	7.7, 3.4, 7.3–8	7.6, 3.4, 7.1–8.1
Stigma (4–20)	6.7, 1.6, 6.6–6.9	6.4, 2.5, 6.2–6.7	6.7, 2.6, 6.4–6.9	6.1, 2, 5.9–6.3	7, 2.8, 6.8–7.2	7.3, 3.1, 7–7.6	6.7, 2.8, 6.3–7.1
Work/school (5–25)	6.2, 2.8, 6–6.3	5.7, 2.6, 5.4–6	6.2, 2.7, 5.9–6.5	5.5, 2.3, 5.4–5.7	6.4, 2.9, 6.2–6.6	6.7, 3.2, 6.3–7	6.2, 2.7, 5.9–6.6
Threat (4–20)	4.7, 1.8, 4.7–4.8	4.7, 1.7, 4.4–5	4.7, 1.7, 4.5–4.8	4.4, 1.3, 4.2–4.5	4.8, 1.5, 4.7–5	5.1, 2.2, 4.9–5.3	4.7, 2.2, 4.4–4.9

Note. Means, confidence intervals, and percentages are all reported using weighted values. Frequencies are unweighted. Income was missing for 8% of participants, and alcohol use was missing for 33%. All other variables were missing for < 1% of respondents. SD standard deviation

triglycerides ($\beta = 0.07, 0.01–0.13$ 95% CI). Finally, higher Work/School Discrimination scores were associated with lower HDL ($\beta = -0.08, -0.13–-0.03$ 95% CI) and glucose levels ($\beta = -0.06, -0.11–-0.01$ 95% CI).

Among individuals of Dominican background, higher Brief PEDQ-CV total scores ($\beta = -0.08, -0.15–-0.01$ 95% CI) and Work/School Discrimination scores ($\beta = -0.11, -0.17–-0.04$ 95% CI) were associated with lower systolic BP. Among individuals of Mexican background higher scores on the Exclusion/Rejection subscale were related to lower systolic BP ($\beta = -0.05, -0.10–-0.01$ 95% CI). Among individuals of Central American background, higher Threat/Aggression scores were associated with larger waist circumference ($\beta = 0.12, 0.02–0.23$ 95% CI) and higher triglycerides ($\beta = 0.09, 0.02–0.17$ 95% CI). No significant associations were seen between Brief PEDQ-CV total or subscale scores and MetS components among individuals of Puerto Rican or South American background.

Discussion

The present study examined associations among perceived discrimination and MetS among a diverse sample of Hispanics/Latinos. With regard to MetS prevalence, the only significant association found reflected that increased perceived ethnicity-associated threat to oneself or one’s property was related to increased MetS prevalence among individuals of Central American background. With regard to individual MetS components, when the sample was examined in aggregate only higher perceived discrimination at work/school was associated with larger waist circumference. This suggests that perceived discrimination was only minimally associated with cardiovascular risk among the present sample of Hispanic/Latino adults.

Examination of the relationships among perceived discrimination and MetS within each Hispanic/Latino background group separately identified some significant relationships, with differential patterns of association across background groups. Additionally, these relationships were all relatively small, and notably smaller than the relationship observed with MetS prevalence, with standardized regression coefficients ranging from 0.04 to 0.13. The largest number of significant associations was found among individuals of Cuban descent. In this group all four subscales and the total score of the Brief PEDQ-CV were associated with higher diastolic BP. This is consistent with prior findings that diastolic BP, but not systolic BP, is associated with perceived discrimination among African Americans [43, 44]. It has been hypothesized that episodes of discrimination may not be associated with active coping efforts, which would likely increase heart rate and systolic BP, but rather a more typical response may involve passive coping efforts and increased vigilance that could be

Table 2 Associations of Brief PEDQ-CV Total scores with MetS prevalence and components

Outcome	Overall		Dominican		Central American		Cuban		Mexican		Puerto Rican		South American	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Unadjusted														
MetS	-0.02	0.02	-0.09	0.07	0.09	0.08	-0.06	0.06	< 0.01	0.05	-0.05	0.05	0.01	0.08
Adjusted														
MetS	0.02	0.02	-0.06	0.06	0.13	0.07	0.03	0.04	0.02	0.04	-0.03	0.05	0.01	0.07
Waist circumference	0.03	0.02	-0.02	0.06	0.08	0.06	0.05	0.04	0.02	0.03	0.04	0.04	-0.03	0.06
SBP	-0.01	0.02	-0.08*	0.04	0.06	0.05	0.05	0.04	-0.04	0.02	-0.03	0.03	0.01	0.05
DBP	0.02	0.02	< 0.01	0.04	0.08	0.06	0.13*	0.04	-0.04	0.04	0.01	0.04	0.08	0.06
Triglycerides ^a	-0.01	0.02	-0.01	0.05	0.04	0.06	0.03	0.04	-0.01	0.03	-0.05	0.04	0.03	0.07
HDL cholesterol	-0.01	0.02	0.05	0.06	-0.02	0.05	-0.06	0.04	-0.02	0.04	< 0.01	0.04	0.08	0.05
Fasting glucose ^a	< 0.01	0.02	< 0.01	0.04	0.02	0.04	-0.06*	0.03	0.04	0.03	-0.02	0.04	< 0.01	0.05

MetS metabolic syndrome, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein, SE standard error

* $p < 0.05$

^a Variable was natural log transformed prior to analysis due to non-normality

associated with greater vascular reactivity and elevated diastolic BP, as was observed in the present study [44]. Interestingly, diastolic BP was not related to perceived discrimination for any of the other background groups examined. Prior analysis of the HCHS/SOL parent study sample demonstrated a higher prevalence of elevated BP among individuals of Cuban background as compared to other Hispanic/Latino backgrounds [3]. Furthermore, high BP is one of the most prevalent components of MetS among men and women of Cuban background [3]. Present results suggest that perceived discrimination may be particularly associated with this MetS component in this group. Though one may expect this to be due to higher reported levels of perceived discrimination, ANOVA demonstrated that individuals of Cuban background had *lower* Brief PEDQ-CV total and subscale scores as compared to other Hispanic/Latino background groups in the present sample (data not shown) [24]. This is consistent with a separate population-based study, which demonstrated that individuals of Cuban descent were less likely to perceive discrimination than other Hispanic/Latino background groups [45]. These differences in perceived discrimination may be attributable to variability in sociodemographic and acculturation variables [24]. However, in the present study associations between perceived discrimination and cardiovascular health were evaluated after controlling for these variables as covariates. This suggests that something beyond what was captured in the present analysis is driving the association between perceived discrimination and elevated BP among individuals of Cuban descent. Similarly, previous research has shown that, despite lower reported levels of discrimination, the relationship between discrimination and psychological distress is stronger among Hispanics/Latinos of Cuban descent than

other background groups [46]. Prior research has also supported associations between psychological distress and cardiovascular risk factors among individuals who participated in the HCHS/SOL, including those of Cuban background [47]. Thus, while individuals of Cuban descent reported lower levels of perceived discrimination in the present study, it is possible that perceived discrimination contributed more strongly to psychological distress, which in turn was associated with increased BP.

In addition, among individuals of Central American background, perceived discrimination in the form of threat/aggression was associated with increased triglycerides and waist circumference. Abdominal obesity has been identified as the most prevalent component of MetS among Hispanic/Latino individuals who meet diagnostic criteria for the syndrome [3]. Present results suggest that this component of MetS is likely impacted by perceived discrimination only among individuals of Central American background when it is experienced as verbal or physical threat or harassment, or when Hispanics/Latinos are considered as a single, large group when it is experienced at work or at school. Given the high prevalence of abdominal obesity, future research would benefit from continued exploration of correlates and processes underlying this component of MetS among Hispanic/Latino adults living in the USA.

Interestingly, and inconsistent with prior literature, three paths were found between perceived discrimination variables and lower fasting glucose among individuals of Cuban background. Additionally, perceived discrimination was associated with lower systolic BP among individuals of Mexican and Dominican background, also inconsistent with prior literature. In their recent review Ryan and colleagues theorized that

Table 3 Associations of Brief PEDQ-CV Exclusion/Rejection scores with MetS prevalence and components

Outcome	Overall		Dominican		Central American		Cuban		Mexican		Puerto Rican		South American	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Unadjusted														
MetS	-0.02	0.02	< 0.01	0.08	0.04	0.07	-0.07	0.05	-0.02	0.04	> -0.01	0.06	-0.05	0.08
Adjusted														
MetS	0.01	0.02	-0.03	0.05	0.05	0.07	0.03	0.04	0.01	0.03	-0.01	0.06	-0.03	0.08
Waist circumference	0.01	0.02	-0.07	0.06	0.01	0.05	0.04	0.04	0.02	0.03	0.06	0.04	-0.06	0.06
SBP	-0.02	0.02	-0.07	0.04	0.06	0.04	0.03	0.04	-0.05*	0.02	-0.05	0.03	0.04	0.05
DBP	0.03	0.02	-0.02	0.04	0.10	0.05	0.12**	0.04	-0.03	0.03	> -0.01	0.04	0.06	0.06
Triglycerides ^a	0.01	0.02	0.01	0.05	0.02	0.05	0.07*	0.03	< 0.01	0.03	< 0.01	0.04	0.02	0.06
HDL cholesterol	-0.02	0.02	0.03	0.06	-0.04	0.06	-0.04	0.04	-0.02	0.04	-0.04	0.04	0.08	0.05
Fasting glucose ^a	> -0.01	0.02	-0.02	0.04	-0.03	0.04	-0.04	0.04	0.04	0.03	-0.02	0.04	-0.02	0.06

MetS metabolic syndrome, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein, SE standard error

* $p < 0.05$, ** $p < 0.01$

^a Variable was natural log transformed prior to analysis due to non-normality

perceived discrimination may impact systolic BP via denial-based coping strategies, which were not specifically explored in the present study [13]. Additionally, prior studies have shown that the impact of perceived discrimination on health may vary based on sex [48]. While efforts were made to balance sex within each Hispanic/Latino background group included in the present study, groups were nonetheless slightly unequal, which may have contributed to these counterintuitive findings. Moreover, it has previously been shown that different Hispanic/Latino background groups have different demographic profiles (e.g., individuals of Cuban background tend to be older and more highly educated) and may immigrate to the USA for different reasons (e.g., political motivations for individuals of Cuban background who immigrated following

the Cuban revolution, economic for those of Mexican background, professional for those of South American background, non-applicable for those of Puerto Rican background who are legally citizens of the USA) [24, 25]. Different Hispanic/Latino background groups may also be differentially likely to become naturalized citizens of the USA [49]. These distinct experiences may lead individuals of different background groups to be more or less susceptible to the impact of culture-related stressors on health behaviors and outcomes, and more or less likely to use approach versus avoidance based coping strategies in response to those stressors. Future research would benefit from additional examination of these relationships, as well as exploration of potential mechanisms underlying this association.

Table 4 Associations of Brief PEDQ-CV Stigmatization/Disvaluation scores with MetS prevalence and components

Outcome	Overall		Dominican		Central American		Cuban		Mexican		Puerto Rican		South American	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Unadjusted														
MetS	-0.03	0.2	-0.12	0.07	0.04	0.08	-0.10	0.05	0.02	0.04	-0.05	0.05	> -0.01	0.09
Adjusted														
MetS	0.02	0.02	-0.04	0.06	0.12	0.07	-0.01	0.05	0.04	0.04	0.01	0.05	0.02	0.08
Waist circumference	0.01	0.02	0.01	0.06	0.06	0.05	-0.02	0.04	0.03	0.03	> -0.01	0.04	-0.07	0.06
SBP	> -0.01	0.02	-0.05	0.04	0.02	0.05	0.02	0.03	-0.01	0.03	> -0.01	0.04	0.02	0.05
DBP	0.02	0.02	0.01	0.04	0.02	0.06	0.09*	0.04	-0.03	0.04	< 0.01	0.04	0.08	0.06
Triglycerides ^a	-0.03	0.02	< 0.01	0.04	-0.01	0.06	-0.02	0.03	-0.02	0.04	-0.06	0.04	0.04	0.07
HDL cholesterol	-0.01	0.02	0.01	0.06	-0.06	0.05	-0.01	0.03	-0.02	0.04	0.01	0.04	0.08	0.05
Fasting glucose ^a	0.02	0.02	0.01	0.06	0.01	0.03	-0.04	0.02	0.04	0.03	0.02	0.04	0.04	0.05

MetS metabolic syndrome, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein, SE standard error

* $p < 0.05$

^a Variable was natural log transformed prior to analysis due to non-normality

Table 5 Associations of Brief PEDQ-CV Work/School Discrimination scores with MetS prevalence and components

Outcome	Overall		Dominican		Central American		Cuban		Mexican		Puerto Rican		South American	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Unadjusted														
MetS	> -0.01	0.02	-0.10	0.07	0.08	0.08	-0.02	0.06	0.04	0.04	-0.07	0.06	0.07	0.08
Adjusted														
MetS	.01	0.02	-0.10	0.06	0.11	0.07	0.05	0.05	0.02	0.04	-0.06	0.05	0.03	0.07
Waist circumference	0.04*	0.02	0.03	0.06	0.09	0.05	0.06	0.04	0.01	0.03	0.06	0.04	0.06	0.05
SBP	-0.02	0.01	-0.11**	0.03	0.04	0.05	0.06	0.04	-0.04	0.02	-0.03	0.03	-0.03	0.04
DBP	0.01	0.02	0.01	0.04	0.05	0.06	0.07*	0.04	-0.04	0.04	> -0.01	0.04	0.06	0.06
Triglycerides ^a	> -0.01	0.02	-0.02	0.05	0.03	0.06	0.04	0.04	< 0.01	0.03	-0.06	0.04	-0.01	0.06
HDL cholesterol	-0.01	0.02	0.08	0.06	0.07	0.05	-0.08**	0.03	-0.02	0.04	> -0.01	0.03	0.06	0.05
Fasting glucose ^a	> -0.01	0.02	> -0.01	0.04	0.06	0.05	-0.06*	0.03	0.01	0.03	-0.02	0.04	-0.01	0.04

MetS metabolic syndrome, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein, SE standard error

* $p < 0.05$, ** $p < 0.01$

^a Variable was natural log transformed prior to analysis due to non-normality

This study had several limitations. The cross-sectional design precluded evaluating causality, and may contribute to the inconsistent directions of relationships observed among perceived discrimination and MetS. Furthermore, because the path analytic models were run for each Hispanic/Latino background group separately, no statistical comparisons could be made across groups regarding the relationships of perceived discrimination to MetS. Thus, conclusions regarding the associations found must be considered preliminary and interpreted cautiously. Moreover, it is possible that other variables that were not considered in the present analyses, such as use of medications impacting components of MetS (e.g., lipid, glucose, or BP-lowering medications), may have impacted study results and contributed to some of the study's counterintuitive

findings. Additionally, though the Brief PEDQ-CV has previously been used to demonstrate associations between perceived discrimination and health outcomes among Hispanics/Latinos [24], the domains evaluated by this measure reflect only a subset of those that contribute to perceived discrimination. Finally, it should be noted that because participants were recruited from four major US metropolises, the findings may not generalize to Hispanics/Latinos living elsewhere.

Despite these limitations, the present findings provide preliminary information regarding the association of perceived discrimination with levels of MetS components among Hispanics/Latinos. Perceived discrimination was not strongly or consistently associated with cardiovascular risk in the

Table 6 Associations of Brief PEDQ-CV Threat/Aggression scores with MetS prevalence and components

Outcome	Overall		Dominican		Central American		Cuban		Mexican		Puerto Rican		South American	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Unadjusted														
MetS	-0.02	0.02	-0.10	0.08	0.15*	0.07	-0.01	0.05	-0.03	0.04	-0.05	0.05	0.02	0.08
Adjusted														
MetS	< 0.01	0.02	-0.05	0.06	0.17**	0.06	0.02	0.04	-0.01	0.04	-0.04	0.05	0.04	0.08
Waist circumference	0.04	0.02	> -0.01	0.06	0.12*	0.05	0.08	0.06	0.04	0.04	0.01	0.04	-0.02	0.05
SBP	0.01	0.01	0.01	0.04	0.06	0.05	0.03	0.02	> -0.01	0.02	> -0.01	0.03	-0.01	0.05
DBP	0.02	0.02	0.04	0.05	0.08	0.06	0.10**	0.04	-0.04	0.03	0.03	0.04	0.07	0.07
Triglycerides ^a	-0.03	0.02	-0.05	0.04	0.09*	0.04	-0.02	0.05	-0.04	0.04	-0.04	0.04	0.06	0.09
HDL cholesterol	0.02	0.02	0.04	0.06	-0.05	0.05	-0.02	0.03	0.02	0.04	0.07	0.04	0.02	0.05
Fasting glucose ^a	0.01	0.02	0.02	0.06	0.04	0.04	-0.08*	0.03	0.04	0.02	-0.04	0.03	0.02	0.05

MetS metabolic syndrome, SBP systolic blood pressure, DBP diastolic blood pressure, HDL high-density lipoprotein, SE standard error

* $p < 0.05$, ** $p < 0.01$

^a Variable was natural log transformed prior to analysis due to non-normality

present sample. Evaluating MetS components among distinct Hispanic/Latino groups separately did identify some relationships; however, the patterns of association did not elucidate a clear risk relationship, suggesting that perceived discrimination may have only a small role with regard to cardiovascular risk among Hispanics/Latinos. Thus, based on these results, clinical and research efforts to decrease cardiometabolic risk among this population may benefit from focusing on other known correlates of increased risk rather than perceived discrimination. Future research should prospectively examine differential patterns associating other aspects of stress with cardiometabolic risk to identify optimal intervention targets to improve health outcomes among diverse Hispanics/Latinos living in the USA.

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Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare that they have no conflict of interest.

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