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Impact of Change Over Time in Self-Reported Discrimination on Blood Pressure: Implications for Inequities in Cardiovascular Risk for a Multi-Racial Urban Community

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Abstract

Objectives—The 21st century has seen a rise in racism and xenophobia in the United States. Few studies have examined the health implications of heightened institutional and interpersonal racism. This study examines changes in reported discrimination and associations with blood pressure over time among non-Latino Blacks (NLBs), Latinos, and non-Latino Whites (NLWs) in an urban area, and variations by nativity among Latinos.

Design—Data from a probability sample of NLB, Latino, and NLW Detroit, Michigan residents were collected in 2002–2003, with follow-up at the same addresses in 2007–2008. Surveys were

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completed at 80% of eligible housing units in 2008 (n=460). Of those, 219 participants were interviewed at both time points and were thus included in this analysis. Discrimination patterns across racial/ethnic groups and associations with blood pressure were examined using generalized estimating equations.

Results—From 2002–2008, NLBs and Latinos reported heightened interpersonal and institutional discrimination, respectively, compared with NLWs. There were no differences in associations between interpersonal discrimination and blood pressure. Increased institutional discrimination was associated with stronger increases in systolic and diastolic blood pressure for NLBs than NLWs, with no differences between Latinos and NLWs. Latino immigrants experienced greater increases in blood pressure with increased interpersonal and institutional discrimination compared to US-born Latinos.

Conclusions—Together, these findings suggest that NLBs and Latinos experienced heightened discrimination from 2002–2008, and that increases in institutional discrimination were more strongly associated with blood pressure elevation among NLBs and Latino immigrants compared to NLWs and US-born Latinos, respectively. These findings suggest recent increases in discrimination experienced by NLBs and Latinos, and that these increases may exacerbate racial/ethnic health inequities.

Keywords

discrimination; blood pressure; cardiovascular risk; Latino; Hispanic; non-Latino Black; non-Hispanic Black; non-Latino White; non-Hispanic White; immigrant; immigration policy; health disparities; health inequities

INTRODUCTION

The 21st century has seen heightened racism and xenophobia in the United States (Golash-Boza 2012; Orelus 2012; DeGenova 2004; Miller 2014; Cox and Miles 2013; Alexander 2012). Despite cross-sectional evidence linking racism with poor health outcomes (Paradies et al. 2015), few studies have examined the health implications of increased structural and interpersonal racism over time. We extend the literature by examining changes in self-reported discrimination between 2002 and 2008, a period of heightened discrimination against non-Latino Black (NLB) (Orelus 2012; Alexander 2012) and Latino communities (Golash-Boza 2012; Cox and Miles 2013; Miller 2014), and test associations with changes in blood pressure in a multi-racial sample in Detroit, Michigan.

Following Williams and colleagues (2009; 1994), we conceptualize discrimination as the differential treatment of people by institutions or individuals, based on social status(es) or identities that are socially constructed as inferior relative to the dominant group. Discrimination is one pathway by which social inequalities such as racism or xenophobia and other prejudices, ideologies, and institutional barriers (e.g., classism or sexism) may affect health (Williams and Mohammed 2009; Paradies et al. 2015; Lewis, Cogburn, and Williams 2015). Multiple interconnected social locations shape the lived experiences of race/ethnicity and social context on these processes (Viruell-Fuentes, Miranda, and Abdulrahim 2012; Crenshaw 1989). Accordingly, the study of the health implications of discrimination-

related stressors has included, but is not limited to, self-reported discrimination that respondents attribute to their race/ethnicity and reported experiences of discrimination in general (i.e. not limited to the respondents' race/ethnicity) (Lewis, Cogburn, and Williams 2015; Williams and Mohammed 2009). While few studies have examined conceptual and empiric differences in these measures, to date the literature is mixed regarding the nature of associations of racial/ethnic discrimination and general discrimination with health (Williams and Mohammed 2009; Pascoe and Richman 2009; Lewis, Cogburn, and Williams 2015). The following section describes the growing evidence base of heightened discrimination against NLB and Latino communities in the US. We then review the literature regarding longitudinal associations of racial/ethnic discrimination and general discrimination with health for samples that include US-based adults.

Increases in discrimination among NLB (Orelus 2012) and Latino (Golash-Boza 2012; Cox and Miles 2013) communities have been documented during this period. Heightened and racialized immigration enforcement and anti-immigrant sentiments have contributed to restricted mobility; undermined trust in health care, police, and governmental organizations; increased deportations; separation of families; and adverse health outcomes among Latinos (Hardy et al. 2012; White et al. 2014; Lopez et al. 2016; Pedraza, Nichols, and LeBrón 2017; Novak, Geronimus, and Martinez-Cardoso 2017). In Detroit, a northern border community in the US, immigration enforcement increased substantially in the early 21st century (Miller 2014; TRAC Immigration 2009b, 2009a). During this same period, NLBs have been overrepresented in prisons (Alexander 2012), with evidence of rising aggression against NLBs by law enforcement (Krieger et al. 2015), and increases in hate crimes (Southern Poverty Law Center 2014), particularly those attributed to ancestral or national affiliation (Drake 2014). While both general discrimination and racial/ethnic discrimination have been associated with adverse health outcomes in cross-sectional studies (Paradies et al. 2015; Lewis, Cogburn, and Williams 2015; Williams and Mohammed 2009; Pascoe and Richman 2009), few studies have examined the health implications of heightened discrimination over time.

In one of the few longitudinal analyses, Cozier and colleagues (2014) found that among a national sample of NLB women, those reporting higher baseline institutional racial/ethnic discrimination and interpersonal discrimination experienced increased incidence of obesity over a twelve year period. Kwarteng and colleagues (2016) reported that higher baseline interpersonal discrimination was associated with increased central adiposity over six years for a multi-racial urban sample. For a national, multi-racial sample of women, Moody and colleagues (2014) found that baseline interpersonal discrimination was positively associated with C-reactive protein – an indicator of internal inflammation associated with several chronic conditions - for non-obese women over a seven-year period.

Some studies have examined whether increases in discrimination are associated with poorer health. Schulz and colleagues (2006) found that heightened interpersonal discrimination was associated with increased depressive symptoms and poorer self-rated health over five years among NLB Detroit women. Studies suggest that health implications of changes in discrimination differ by gender, racial/ethnic group, and discrimination trajectories. Hunte and colleagues (2011) reported that among a sample of predominantly NLWs, men reporting

consistently high interpersonal discrimination and women reporting increased interpersonal discrimination experienced greater increases in waist circumference than their counterparts who reported limited discrimination over nine years. Cunningham and colleagues (2013) reported that over an eight year period, increases in racial/ethnic institutional discrimination were associated with increased waist circumference and body mass index for NLB women, but not NLW women or NLB or NLW men. The authors conjecture that these differences in associations for NLB women relative to NLW women and men may be attributed to the measurement of racial/ethnic discrimination. In understanding divergent associations of racial/ethnic discrimination with metabolic dysregulation for NLB women and men, the authors posit gender differences in threat assessments and/or coping responses to racial/ethnic discrimination.

This literature suggests associations between discrimination and health over time, with variations in patterns by baseline and longitudinal discrimination, gender, and race/ethnicity. This evidence base is consistent with intersectionality theory (Viruell-Fuentes, Miranda, and Abdulrahim 2012; Crenshaw 1989), suggesting the importance of considering multiple social statuses together in the study of discrimination and health. Notably, the majority of studies to date have not disentangled differences in patterns of interpersonal and institutional discrimination over time and associations with health. Relatively few studies have considered longitudinal associations between discrimination and health with samples that include Latinos (Kwarteng et al. 2016).

Drawing on longitudinal data, we examined self-reported discrimination among NLBs, Latinos, and NLWs between 2002–2008. Discrimination includes interpersonal (e.g., daily activities) and institutionalized (e.g., education, housing institutions) discrimination (Schwalbe et al. 2000; Williams, Yu, and Jackson 1997), with discrimination measures assessing reports of general discrimination. We tested the hypotheses that NLBs and Latinos would report greater increases in interpersonal and institutional discrimination during this period than NLWs, and that these increases would be associated with greater increases in blood pressure, contributing to heightened inequities in blood pressure between Latinos and NLBs relative to NLWs. If these hypotheses are substantiated, findings would suggest that heightened discrimination contributes to racial/ethnic inequities in blood pressure. Due to heightened immigration surveillance during this period, we also explored whether these dynamics varied by nativity among Latinos. That is, within a socio-political context of restrictive immigration policies and anti-immigrant sentiments, do Latino immigrants experience heightened discrimination and blood pressure over time compared with Latinos born in the US?.

MATERIALS AND METHODS

Sample

Data were from the Healthy Environments Partnership (HEP) 2002–2003 (henceforth, 2002) and 2007–2008 (henceforth, 2008) Community Surveys. HEP, a community-based participatory research partnership, has been working since 2000 to understand, and to develop, implement, and evaluate interventions to address, excess cardiovascular risk in Detroit, Michigan (Schulz et al. 2005). The 2002 survey was completed with a stratified,

two-stage probability sample of occupied housing units in three geographic areas of Detroit, designed to sample NLB, Latino, and NLW residents across socioeconomic strata. The sampling frame was designed for 1,000 interviews with persons aged ≥ 25 years (Schulz et al. 2005). NLWs were oversampled, yielding a total sample of 919 participants in 2002. At baseline, face-to-face interviews were conducted with 75% of housing units in which an eligible respondent was identified (919 out of 1,220) and 90% of housing units in which an eligible respondent was contacted (919 out of 1,027) (Schulz et al. 2005; Kwarteng et al. 2016). Post stratification weights that account for the sampling design were constructed to ensure appropriate representation of racial/ethnic groups across socioeconomic positions and adjusted for probabilities of selection within strata, non-response bias, and to match the Census distributions of the broader population of Detroit residents (Schulz et al. 2005; Schulz et al. 2013).

Follow-up interviews were conducted in 2008, when interviewers contacted originally sampled housing units that remained "active" (e.g., not vacant or demolished) at follow-up (703 out of the 919; 76%). To preserve contextual data linked with the originally sampled housing units, the following sampling strategy was used: persons interviewed in 2002 still living in the same housing unit were re-interviewed; if there were new residents in the household, a randomly selected current adult resident was interviewed. Follow-up face-to-face interviews were conducted with 65% of housing units in which an eligible respondent was identified (460 out of 703) and 80% of housing units in which an eligible respondent was contacted (460 out of 577). Of those, 219 (48%) were interviewed in both 2002 and 2008, and analyses reported here are with that subset of the sample. A unique feature of this dataset is that it provides variables from the same participants over time, facilitating an examination of changes in discrimination and cardiovascular risk. Despite the relatively small sample, few datasets are better suited to test the hypotheses of variations over time and across racial/ethnic groups. The University of Michigan Institutional Review Board approved this study. Procedures accorded with the Declaration of Helsinki and participants provided informed consent prior to the study.

Measures

Dependent variables—Dependent variables for tests of the first hypothesis were interpersonal and institutional discrimination, derived from survey data in 2002 and 2008. Dependent variables for the second hypothesis, systolic (SBP) and diastolic (DBP) blood pressure, were derived during the interview using a portable cuff device (Omron model HEM 711AC) that passed Association for the Advancement of Medical Instrumentation Standards (Yarrows and Brook 2000), and were collected in both 2002 and 2008. Trained interviewers collected blood pressure measures three times during each interview, which took place at the participant's home. Systolic and diastolic blood pressure were calculated as the mean of the second and third blood pressure measurements (LeBrón et al. 2015; LeBrón et al. In Press).

Interpersonal discrimination was measured by the mean of the 5-item Everyday Unfair Treatment Scale (Williams, Yu, and Jackson 1997) including the frequency with which respondents reported: being treated with less courtesy or respect; receiving poorer service at

restaurants or stores; people acting as if the respondent was not smart; people acting afraid of the respondent; and feeling threatened or harassed. Response options ranged from never (1) to always (5) (Cronbach's alpha: 0.76 (2002), 0.77 (2008)). Institutional discrimination was measured by the sum of responses to the 7-item Acute Unfair Treatment index (Williams, Yu, and Jackson 1997) assessing lifetime experiences of unfair treatment in work, education, by the police or immigration officials, housing, obtaining resources/money, or health care (1=yes, 0=no).

Independent variables—For the second hypothesis, interpersonal and institutional discrimination were time-varying independent variables. Race and ethnicity are socially-constructed categories that vary over time and place (Omi and Winant 2015; Almaguer 2009). In the United States, the Office of Management and Budget designates racial and ethnic categories, which are in turn used by the US Census Bureau and inform approaches to the study of racial/ethnic health disparities in the US (Alcoff 2005). Racial/ethnic group was assessed by self-reported Hispanic/Latino descent and by race, using US Census 2000 classifications: White/Caucasian, Black/African American, American Indian, Asian, Pacific Islander, or an Other race. Participants of Hispanic/Latino descent were classified as Latino, regardless of racial group, and this variable was treated as time-invariant. Analyses were limited to Latino, NLB, and NLW participants due to small numbers in other categories. Participants who identified as an Other non-Latino group (n=6) were included in this analysis, but coefficients were not interpreted (Zenk et al. 2017; Schulz et al. 2012). In longitudinal models, to account for survey period when the interview was completed, we included a "time" indicator in the models (0=2002; 1=2008). Nativity was assessed among Latino participants (0=born in continental US/Puerto Rico, 1=immigrant).

Covariates included: Age (<45 years, 45–59 years, and 60+ years (referent)); self-reported gender (0=male, 1=female); ratio of household income to the poverty threshold for the respective year, accounting for household size (U.S. Census Bureau 2012) (0=at/below poverty; 1=above poverty); education (<high school (referent); high school education or GED, >high school); employment (0=not working for pay; 1=working for pay); marital status (0=not married/living with partner; 1=married/living with partner), and antihypertensive medication use (0=no; 1=yes) for participants who met the criteria for hypertension (defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or taking antihypertensive medication) (LeBrón et al. In Press).

Analysis

Descriptive statistical techniques assessed the patterning of variables. Sampling weights were applied to each model. Due to the longitudinal design, we used generalized estimating equations to examine associations over time between racial/ethnic groups and time-varying discrimination, and between time-varying discrimination and time-varying blood pressure from 2002–2008. Models testing our directional hypothesis included two- and/or three-way interactions, as needed. For example, interactions of racial/ethnic group and time were included in models assessing racial/ethnic differences in discrimination over time. In models including three-way interactions, there were at least 20 participants included in each cell. Generalized estimating equations account for within-subject correlation to estimate the best

linear unbiased parameter estimates while accommodating the within-individual correlation of data in 2002 and 2008 (Ballinger 2004; Zeger, Liang, and Albert 1988; Zorn 2001). Analyses were conducted in SAS 9.4.

RESULTS

Unweighted descriptive statistics for the 219 participants with repeated measures (Table 1) indicate that a greater proportion of NLBs (75.7%) were female relative to Latinos (54.2%) and NLWs (53.2%). At baseline, the mean age of Latinos (mean=44.8 years) was lower than that of NLBs (mean=49.6 years) and NLWs (mean=51.4 years). In 2002, there was no significant racial/ethnic difference in the proportion of participants who had household incomes above poverty, ranging from 61.7% to 69.2%, reflecting the stratified sampling design. At follow-up, a lower proportion of Latinos (55.9%) had household incomes above poverty relative to NLWs (68.1%) and NLBs (67.3%), reflecting a significant decline in the percent of Latinos with household incomes above poverty. Among participants who met the criteria for hypertension, fewer NLWs (2002: 23.8%; 2008: 50.0%) were taking antihypertensive medication than NLBs (2002: 67.2%; 2008: 79.7%); with no statistically significant differences for Latinos (2002: 40.0%; 2008: 65.5%) relative to NLWs or NLBs.

Tests of the hypothesis that changes in discrimination differed by racial/ethnic group (Table 2) indicate that NLBs (β=0.27, p=0.01) and Latinos (β=0.23, p=0.06) reported increases in interpersonal discrimination that were significantly and marginally significantly distinguishable from NLWs, respectively (Model 1). Similarly, NLBs (β=0.40, p=0.05) and Latinos (β=0.56, p=0.02) reported marginally significantly and significantly greater increases in institutional discrimination compared with NLWs, respectively (Model 2).

Results from tests of the hypothesis that differential changes in discrimination would be associated with differential blood pressure patterns (Table 3) do not support the hypothesis of racial/ethnic differences in associations between interpersonal discrimination and SBP (NLBs: β=6.89, p=0.44; Latinos: β=−4.03, p=0.68; Model 1) or DBP (NLBs: β=4.48, p=0.44; Latinos: β= −0.85, p=0.89; Model 3). Models 2 and 4 suggest that NLBs experience a stronger association between increases in institutional discrimination with SBP (β=7.73, p=0.03) and DBP (β=4.00, p=0.09) compared with NLWs. There is no evidence of differences in associations of institutional discrimination with SBP (β=0.90, p=0.84) or DBP (β=0.24, p=0.93) between Latinos and NLWs.

In models restricted to Latinos (Table 4), tests of variations by nativity find no significant differences in the association between changes in interpersonal discrimination and SBP for immigrant (β=7.46, p=0.44) relative to US-born Latinos (Model 1), with significantly greater increases in DBP with increases in interpersonal discrimination for immigrant (β=16.47, p=0.01) compared to US-born Latinos (Model 3). Increases in institutional discrimination were associated with significantly greater increases in SBP (β=10.85, p=0.02; Model 2) and DBP (β=10.40, p<0.01; Model 4) for immigrant compared to US-born Latinos.

DISCUSSION

There are three major findings of the results reported here. First, we found significant racial/ethnic differences in discrimination patterns over time, with both NLBs and Latinos reporting greater increases in interpersonal and institutional discrimination compared with NLWs. Second, while we found no evidence of racial/ethnic differences in associations between increased interpersonal discrimination and blood pressure, heightened institutional discrimination was more strongly associated with increases in blood pressure among NLBs relative to NLWs. Finally, though we found no differences in associations between institutional discrimination and blood pressure between Latinos and NLWs, within-group comparisons indicated that increases in interpersonal discrimination were associated with significantly greater increases in DBP, and institutional discrimination with greater increases in SBP and DBP, among Latino immigrants. These findings suggest the importance of considering the social context of discrimination and variations in the lived experience of race/ethnicity by multiple social statuses when evaluating the health implications of discrimination (Viruell-Fuentes, Miranda, and Abdulrahim 2012; Ford and Airhihenbuwa 2010). Below, we discuss these findings.

Increases in interpersonal discrimination among NLBs are consistent with our hypothesis of increased discrimination during a period of heightened aggression towards NLBs and persistent racist ideologies expressed in interpersonal exchanges, mainstream and social media, and racialized discourses (Orelus 2012). The marginally significantly greater increase in institutional discrimination for NLBs compared to NLWs is consistent with evidence of persistent and rising trends of race-based residential segregation (Hall, Crowder, and Spring 2015); economic inequalities (Taylor et al. 2011); disinvestments in economic, educational, and employment opportunities for racial/ethnic minorities (Williams and Collins 2001); and legislation a decade prior that disadvantaged racial/ethnic minority communities, such as enhanced local policing (Alexander 2012; Gaber and Wright 2015), increased incarceration (Alexander 2012), and restricted social welfare supports (Lein et al. 2007).

Similarly, while marginally significant, greater increases in interpersonal discrimination for Latinos relative to NLWs over the study period corresponds with escalations in anti-immigrant ideologies expressed in interpersonal interactions and the media, which are linked with recent and previously established anti-immigrant, and by extension, anti-Latino policies (Chavez 2013; DeGenova 2004). Significant increases in institutional discrimination reported by Latinos compared to NLWs aligns with the above mentioned processes of heightened policing (Alexander 2012; Krieger et al. 2015), social and economic disinvestments in racial/ethnic minority communities (Williams and Collins 2001), and increasingly restrictive immigration policies affecting communities who have experienced growth through immigration in recent decades, including Latinos (Golash-Boza 2012; TRAC Immigration 2009b, 2009a; Miller 2014; Rhodes et al. 2015; Pedraza, Nichols, and LeBrón 2017; LeBrón, Lopez, et al. 2017).

Tests of the second hypothesis examined whether the greater increases in discrimination among NLBs and Latinos may be expressed in corresponding increases in blood pressure. Results suggest stronger associations between institutional discrimination and blood

pressure than were found for interpersonal discrimination. These adverse effects were heightened for NLBs and immigrant Latinos.

The stronger association of institutional rather than interpersonal discrimination and blood pressure may reflect different health-related pathways. The interpersonal discrimination measure (Williams, Yu, and Jackson 1997) captured everyday indignities that may influence health through heightened physiological responses to stressful conditions (Pearlin et al. 1981). These pathways may be more variable and/or combined with other stressful conditions that may dampen the visibility of their associations with blood pressure (Williams and Mohammed 2009). Increased institutional discrimination may alter social and economic opportunities fundamental to health (House, Kessler, and Herzog 1990; Phelan, Link, and Tehranifar 2010; Link and Phelan 1995) and heighten exposure to racialized stressors (Viruell-Fuentes, Miranda, and Abdulrahim 2012). The institutional discrimination measure, which assessed barriers to quality housing, employment, or health care or fair treatment from law enforcement may have more immediate or profound implications that alter trajectories of individuals, families, and communities (Williams and Mohammed 2009). Accordingly, institutional discrimination may exact more immediate or greater health consequences than interpersonal discrimination.

The stronger association of interpersonal and institutional discrimination with blood pressure for immigrant relative to US-born Latinos suggests the importance of an intersectional study of discrimination and health and for accounting for the role of nativity and social context in these associations. This study was conducted during a period in which restrictive immigration policies gained a stronghold (Golash-Boza 2012). While immigration policies may affect Latinos regardless of citizenship status or immigrant generation (Golash-Boza 2012; Pedraza, Nichols, and LeBrón 2017), accounting for nativity sharpened variations in associations by nativity that were not visible in models that did not disaggregate immigrant from US-born Latinos. The stronger association found between both interpersonal and institutional discrimination and blood pressure among Latino immigrants may reflect experiences of, or vigilance towards, heightened racism corresponding with restrictive immigration policies and sentiments over the study period. Qualitative research among Latinas has suggested that interpersonal experiences with discrimination may be linked with threats of encounters with institutional agents such as police and immigration enforcement officials, institutional processes with potentially severe implications for immigrant Latinos and their kin networks (LeBrón 2015). Thus, within this particular group, it is plausible that interpersonal discrimination may be even more strongly associated with physiological responses such as heightened blood pressure, or may be more closely aligned with experiences of institutional discrimination and effects on blood pressure, than are observed within other racial/ethnic groups. Additional research is warranted to more clearly understand these variations in associations between interpersonal and institutional discrimination and blood pressure across immigrant generations, and by race/ethnicity.

This analysis is characterized by several limitations. First, data are drawn from 2002 and 2008, time points that straddle escalations in restrictive immigration policies (Golash-Boza 2012; Miller 2014; DeGenova 2004), with baseline data preceding several restrictive state- and local-level immigration policies (Rhodes et al. 2015; Toomey et al. 2014; Kline 2016)

and the Black Lives Matter movement to end structural violence against NLBs (García and Sharif 2015; Cullors, Tometi, and Garza). The latter data collection point intersects with the start of the 2008 economic recession, which differentially affected NLBs and Latinos (Taylor et al. 2011), and thus does not capture consequences of heightened discrimination beyond these time points. Second, limitations of the discrimination measures have been documented (Paradies et al. 2015; Williams and Mohammed 2009; Lewis, Cogburn, and Williams 2015). These measures may not adequately capture the changing context of racism in the US that corresponds with shifting racial and ethnic ideologies and policies that reflect and reinforce these ideologies (e.g., voting rights, government-issued ID, incarceration, deportation) (Alexander 2012; Golash-Boza 2012; LeBrón, Lopez, et al. 2017), contributing to conservative estimates of the influence of heightened discrimination on cardiovascular risk. Third, consistent with other studies based on the Everyday Unfair Treatment and Acute Unfair Treatment scales (Williams, Yu, and Jackson 1997; Schulz et al. 2006; Kwarteng et al. 2016), in the present study, reports of interpersonal or institutional discrimination were not limited to those that participants attributed to their race/ethnicity given that often the multiple social statuses (e.g., race/ethnicity, nativity, language use) to which individuals attribute their experiences of discrimination are difficult to disentangle (Viruell-Fuentes, Miranda, and Abdulrahim 2012; Viruell-Fuentes 2007). Thus, the extent to which participants attributed their experiences of discrimination to their racial/ethnic identification is not considered in these analyses. While additional research is warranted on this topic, an emerging literature suggests mixed associations of racial/ethnic discrimination and general discrimination with health (Williams and Mohammed 2009; Pascoe and Richman 2009). Despite these limitations, these discrimination measures are widely used and amongst the best available to date (Paradies et al. 2015; Williams, Yu, and Jackson 1997; Everson-Rose et al. 2015; Sims et al. 2016; LeBrón et al. 2014). Fourth, the small sample size limited examination of differences by other social statuses. Studies involving larger samples, with data collected over multiple time points over protracted periods may disaggregate racial/ethnic groups by subgroups (e.g., gender, socioeconomic position, country of origin/descent). Further, the small sample size may impede power to detect statistically significant differences in changes in discrimination over time and implications for cardiovascular risk across racial/ethnic groups and across immigrant generations. Despite these limitations, a unique feature of this dataset is that it followed a multi-racial urban sample over time, facilitating examination of the study hypotheses. Fifth, this study was restricted to participants with data at both time points. Of the sample interviewed in 2002, only 577 of the originally sampled 919 housing units were eligible for re-interview in 2008 and were contacted. Of these, 219 participants (38% of the eligible original sample) were re-interviewed in 2008. This was a result of the sampling design, which focused on sampling the same housing unit in order to preserve contextual data (the primary focus of the survey), rather than sampling the same individual. Accordingly, this sample reflects individuals who experience greater residential stability. If individuals who experience greater residential instability are exposed to more stressful life conditions, the results presented here may be conservative. However, tracking individuals longitudinally provides greater statistical power to quantify change over time and generate more precise estimates of the health implications of changes in discrimination over time. Compared to participants who were re-interviewed, participants not re-interviewed were younger, more economically vulnerable, reported

greater discrimination, and had lower blood pressure (data not shown). Reported discrimination (Perez, Fortuna, and Alegria 2008; LeBrón, Spencer, et al. 2017) and blood pressure (Franklin et al. 1997) vary by age, with reports of discrimination declining with increasing age and blood pressure increasing. In the analyses reported here, each individual served as their own control over time. Effects of aging in a cross-sectional setting would be expected to weaken the effects of discrimination, while in the longitudinal setting result in more precise estimates of associations between discrimination and blood pressure over time. Future longitudinal studies, particularly in areas with high mobility such as Detroit, would be helpful in assessing the extent of such bias.

This study also has several strengths. This study empirically tests changes in interpersonal and institutional discrimination, following the same participants over a six-year period (Williams, Yu, and Jackson 1997). There were notable increases in anti-immigrant sentiments and policies (Golash-Boza 2012; Novak, Geronimus, and Martinez-Cardoso 2017; Cox and Miles 2013; Miller 2014; DeGenova 2004) and increased aggression towards racial/ethnic minorities over the study period (Orelus 2012; Alexander 2012; Krieger et al. 2015). The use of repeated measures, based on two datasets that followed community-dwelling residents over time and assessed self-reported discrimination and clinically measured blood pressure, allowed tests of the hypotheses of racial/ethnic differences in increases in discrimination and its adverse implications for blood pressure, associations that have not previously been demonstrated. The use of generalized estimating equations reduces bias in longitudinal analyses by controlling for measured and unmeasured covariates by designating each participant as her/his own control (Ballinger 2004), providing a robust method for assessing the longitudinal association of discrimination with blood pressure. This is the first study of which we are aware to demonstrate stronger associations between escalations in institutional discrimination and blood pressure among NLBs compared with NLWs and among immigrant relative to US-born Latinos. These findings join evidence of heightened racism towards Latinos (Golash-Boza 2012; Rhodes et al. 2015; LeBrón 2015) and NLBs (Orelus 2012) and are consistent with studies demonstrating adverse health implications of discrimination over time (Cunningham et al. 2013; Schulz et al. 2006).

Additionally, this study was conducted in Detroit, MI, a city along the US-Canada border and characterized by sizable Latino and NLB populations. Few studies have examined discrimination against Latinos in the Midwest (Dreby 2013; Lopez et al. 2016; Novak, Geronimus, and Martinez-Cardoso 2017), particularly US-Canada border communities (Viruell-Fuentes and Schulz 2009; Viruell-Fuentes 2007) where immigration enforcement has escalated (Miller 2014). Findings may be generalizable to northern border or other post-industrial communities experiencing similar pressures related to immigration enforcement as well as laws that adversely affect racial/ethnic minority groups, such as enhanced policing and surveillance, reductions in public supports (e.g., public schools), and restricted access to health-promoting resources based on ability to present a U.S. government-issued ID (LeBrón, Lopez, et al. 2017).

Conclusions

Our finding that NLBs and Latinos experienced escalations in interpersonal and institutional discrimination over a six-year period, and that changes in institutional discrimination in particular were associated with greater increases in blood pressure among NLBs and among Latino immigrants suggest that these experiences manifest over a relatively short period (6 years) in compromised cardiovascular health. In the absence of reform to improve social, economic, and political circumstances for racial/ethnic minorities, it is important to monitor the health equity implications of inequalities that disproportionately affect racial/ethnic minorities. Given the stronger association between institutional discrimination and cardiovascular risk, particular attention to the impacts of institutional discrimination on health are warranted. Interventions that focus on disrupting the pathways through which institutional discrimination affects blood pressure may include, for example, improving housing, employment, and educational opportunities for racial/ethnic minorities; and reforming immigration and criminal justice policies.

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Table 1

Descriptive Statistics by Year of HEP Community Survey & Racial/Ethnic Group, Detroit, MI, 2002–2008

Characteristic	2002			2008			2002[b]			2008[b]			2002 vs. 2008[b]		
	Latino (n=59)	NLB (n=107)	NLW (n=47)	Latino (n=59)	NLB (n=107)	NLW (n=47)	Latino vs. NLW	Latino vs. NLB	NLB vs. NLW	Latino vs. NLW	Latino vs. NLB	NLB vs. NLW	Latino	NLB	NLW
Female (%)	54.2	75.7	53.2	54.2	75.7	53.2	NS	*	*	NS	*	*	N/A	N/A	N/A
Age (mean, SD)	44.8 (12.1)	49.6 (14.2)	51.4 (13.1)	50.5 (12.0)	55.9 (14.2)	56.9 (13.7)	*	*	*	*	*	NS	**	**	**
Household above poverty level (%)	67.8	69.2	61.7	55.9	67.3	68.1	NS	NS	NS	*	*	NS	**	NS	NS
Educational Attainment[a]							*	*	*	*	*	*	NS	**	NS
Less than high school (%)	62.7	22.5	40.4	61.0	18.7	40.4									
High school (%)	17.0	30.8	17.0	13.6	26.2	14.9									
More than high school (%)	17.0	46.7	40.4	25.4	55.1	42.6									
Other education (%)	3.3	0.00	2.2	0.00	0.00	2.1									
In labor force (%)	69.5	64.5	70.2	52.5	45.8	51.1	NS	NS	NS	NS	NS	NS	**	**	**
Married/living with partner (%)	54.2	32.7	38.3	50.9	29.9	40.4	*	*	NS	NS	*	*	NS	NS	NS
Antihypertensive Medication Use															
All participants (%)	13.6	40.2	10.6	32.2	51.4	29.8	NS	*	*	NS	*	*	**	**	**
Participants with hypertension (%)	40.0	67.2	23.8	65.5	79.7	50.0	NS	NS	*	NS	NS	*	**	**	**
Discrimination															
Interpersonal (mean, SD)	1.7 (0.6)	1.6 (0.6)	1.7 (0.6)	1.8 (0.7)	1.7 (0.6)	1.6 (0.6)	NS	NS	NS	*	NS	*	NS	**	*
Institutional (mean, SD)	0.6 (1.3)	1.2 (1.4)	1.0 (1.1)	1.0 (1.2)	1.6 (1.8)	1.1 (1.3)	*	*	NS	NS	*	*	**	**	NS
Blood Pressure															
Systolic (mean, SD)	123.1 (15.0)	132.3 (19.1)	131.8 (17.8)	135.5 (24.5)	133.1 (22.2)	134.5 (24.6)	*	*	NS	NS	NS	NS	**	NS	NS
Diastolic (mean, SD)	76.7 (10.8)	82.8 (12.8)	81.3 (11.5)	80.2 (11.4)	80.9 (12.8)	79.4 (13.9)	*	*	NS	NS	NS	NS	**	*	NS

Notes: NLB indicates Non-Latino Black participants; NLW indicates Non-Latino White participants.

[a]Changes in educational attainment attributed to continued education amongst participants;

[b]Descriptive statistics are unweighted. Tests of significance based on unweighted estimates using ANOVA and chi-squared tests (for educational attainment).

*Indicates $P<0.05$,

**Indicates $P<0.01$.

Table 2

Weighted Interpersonal and Institutional Discrimination Regressed on Racial/Ethnic Group, by Time 2002–2008

	Interpersonal Discrimination Model 1			Institutional Discrimination Model 2		
	B	**SE**	***P*-value**	**B**	**SE**	***P*-value**
Intercept	1.61	0.16	<0.01	0.72	0.27	0.01
Latino	−0.04	0.14	0.80	−0.46	0.27	0.09
Non-Latino Black	−0.06	0.12	0.59	0.18	0.21	0.41
Time	−0.16	0.10	0.06	−0.06	0.18	0.37
Latino*Time	0.23	0.15	0.06	0.56	0.28	0.02
Non-Latino Black*Time	0.27	0.12	0.01	0.40	0.24	0.05
QIC		2495.16			2486.38	

Note: Referent groups are non-Latino White participants and 2002 year of data collection. Models are adjusted for age (<45 years, 45–59 years referenced to age 60 or older), gender (female referenced to male), marital status (married/living with partner referenced to not married/living with partner), educational attainment (high school education, more than high school, other education referenced to less than high school education), employment status (working for pay referenced to not working for pay), and household income (household income above poverty referenced to household income less than/at poverty level). QIC indicates goodness of fit statistic for GEE models.

Table 3

Weighted Blood Pressure Regressed on Discrimination, by Discrimination Scale, Time, and Racial/Ethnic Group, 2002–2008

	Systolic Blood Pressure						Diastolic Blood Pressure					
	Interpersonal Discrimination Model 1			Institutional Discrimination Model 2			Interpersonal Discrimination Model 3			Institutional Discrimination Model 4		
	B	SE	*P*-value	B	SE	*P*-value	B	SE	*P*-value	B	SE	*P*-value
Intercept	135.87	11.02	<0.01	132.90	6.69	<0.01	76.53	6.44	<0.01	76.09	3.53	<0.01
Latino	−8.91	12.45	0.47	−2.81	5.66	0.62	−0.33	8.31	0.97	−1.11	3.15	0.73
Non-Latino Black	6.66	12.12	0.58	9.75	5.52	0.08	3.58	7.11	0.61	5.16	3.09	0.10
Discrimination	−0.17	5.63	0.98	2.59	3.13	0.41	1.23	3.24	0.70	3.12	1.74	0.07
Time	1.23	14.26	0.93	5.85	5.40	0.28	0.83	8.54	0.92	2.71	3.48	0.44
Discrimination*Time	0.97	8.05	0.45	−2.81	3.31	0.20	−0.74	5.12	0.89	−3.05	2.14	0.15
Latino*Discrimination	2.63	7.12	0.71	−1.38	3.57	0.70	−2.12	4.56	0.64	−2.38	2.03	0.24
Non-Latino Black*Discrimination	−2.47	6.74	0.71	−6.46	3.37	0.06	−0.95	3.91	0.81	−3.22	2.02	0.11
Latino*Time	14.37	17.73	0.42	5.91	6.33	0.35	5.83	10.44	0.58	3.50	4.37	0.42
Non-Latino Black*Time	−14.98	16.05	0.35	−12.74	6.12	0.04	−8.84	9.97	0.37	−5.75	4.17	0.17
Latino*Discrimination*Time	−4.03	9.75	0.68	0.90	4.51	0.84	−0.85	6.23	0.89	0.24	2.81	0.93
Non-Latino Black*Discrimination*Time	6.89	8.92	0.44	7.73	3.53	0.03	4.48	5.75	0.44	4.00	2.36	0.09
QIC		2484.22			2465.16			2531.97			2509.04	

Note: Referent groups are non-Latino White participants, 2002 year of data collection, and lowest discrimination score. Models are adjusted for age (<45 years, 45–59 years referenced to age 60 or older), gender (female referenced to male), marital status (married/living with partner referenced to not married/living with partner), educational attainment (high school education, more than high school, other education referenced to less than high school education), employment status (working for pay referenced to not currently working for pay), and household income (household income above poverty referenced to household income less than/at poverty level), and antihypertensive medication use (taking antihypertensive medication referenced to not taking antihypertensive medication). QIC indicates goodness of fit statistic for GEE models.

Table 4

Weighted Blood Pressure Regressed on Discrimination for Latinos, by Discrimination Scale, Time, and Nativity, 2002–2008

	Systolic Blood Pressure						Diastolic Blood Pressure					
	Interpersonal Discrimination Model 1			Institutional Discrimination Model 2			Interpersonal Discrimination Model 3			Institutional Discrimination Model 4		
	B	SE	*P*-value	B	SE	*P*-value	B	SE	*P*-value	B	SE	*P*-value
Intercept	124.79	8.73	<0.01	125.45	7.57	<0.01	73.45	7.43	<0.01	76.19	5.48	<0.01
Immigrant	−6.11	13.29	0.65	−15.19	5.35	<0.01	11.51	7.94	0.15	−1.82	4.48	0.68
Discrimination	2.52	5.41	0.64	1.79	1.74	0.30	2.46	3.20	0.44	1.83	0.85	0.03
Time	4.10	8.99	0.65	13.99	4.64	<0.01	11.59	7.13	0.10	9.48	3.79	0.01
Discrimination*Time	2.17	6.11	0.72	−3.13	3.40	0.36	−4.69	3.71	0.21	−5.23	1.81	<0.01
Immigrant*Discrimination	−2.98	7.50	0.69	−5.70	4.22	0.18	−9.42	4.70	0.05	−7.49	2.87	0.01
Immigrant*Time	−13.80	16.00	0.39	−12.23	5.88	0.04	−28.15	10.35	0.01	−7.45	4.88	0.13
Immigrant*Time*Discrimination	7.46	9.61	0.44	10.85	4.67	0.02	16.47	5.89	0.01	10.40	3.04	<0.01
QIC		728.09			738.51			827.24			831.85	

Note: Referent groups are US-born participants, 2002 year of data collection, and lowest discrimination score. Models are adjusted for age (<45 years, 45–59 years referenced to age 60 or older), gender (female referenced to male), marital status (married/living with partner referenced to not married/living with partner), educational attainment (high school education, more than high school, other education referenced to less than high school education), employment status (in labor force referenced to not in labor force), and household income (household income above poverty referenced to household income less than/at poverty level), and antihypertensive medication use (taking antihypertensive medication referenced to not taking antihypertensive medication). QIC indicates goodness of fit statistic for GEE models.