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Stress during Pregnancy: The Role of Institutional Racism

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Abstract

Institutional racism, also known as structural racism, can be defined as differential access to resources and opportunities by race as well as policies, laws, and practices that reinforce racial inequity. This study examines how institutional racism in the form of residential redlining (neighbourhood-level racial inequities in mortgage lending) and segregation (geographic separation of groups by race) is associated with self-reported stress among a diverse cohort of pregnant women. Institutional racism was measured by a residential redlining index using Home Mortgage Disclosure Act data and residential segregation using 2000 US Census data. These redlining and segregation indices were linked with data from a pregnancy cohort study (n = 4652), which included individual measures of reported stress. We ran multilevel linear regression models to examine the association between redlining, segregation and reported stress. Hispanic women compared with all other women were slightly more likely to report stress. There was no significant relationship between redlining and stress among this population. However, higher neighbourhood percentage black was inversely associated with stress. This study suggests that some forms of segregation may be associated with reported stress. Future studies should consider how redlining and segregation may provide an understanding of how institutional racism and the neighbourhood context may influence stress and health of populations.

Keywords

stress; racism; segregation; neighbourhood; pregnancy

Introduction

Stress is a dynamic and multifaceted phenomenon that has been associated with poor health (McEwen & Seeman, 1999). In the context of pregnancy, stress has been associated with several adverse perinatal outcomes such as low birth weight and preterm birth (Culhane,

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Rauh, McCollum, Elo, & Hogan, 2002; Culhane et al., 2001; Dole et al., 2003; Dole et al., 2004; Wadhwa, Culhane, Rauh, Barve, Hogan,et al., 2001; Zambrana, Dunkel-Schetter, Collins, & Scrimshaw, 1999). The physiological responses to chronic exposure to stress can accumulate over time, leading to an enhanced inflammatory response and contributing to compromised fetal development and adverse pregnancy outcomes (Baum, Garofalo, & Yali, 1999; Culhane et al., 2002; James, 1994; McEwen & Seeman, 1999; Wadhwa, Culhane, Rauh, & Barve, 2001). However, perceptions of stress may depend on the source of stress, and physiological responses to stress may be related to an individual's ability or willingness to appraise or report stress (Cohen, Kamarck, & Mermelstein, 1983; Schulz et al., 2008). The sources of stress may vary, and this study focuses on institutional racism and residential contexts as major sources of stress because of their potential to contribute to racial/ethnic inequities in pregnancy health.

Background

Racism and stress

Self-reported stress and racism have been associated with maternal health and birth outcomes, and racism may account for a portion of the observed racial inequity in pregnancy and birth outcomes (Collins, David, Handler, Wall, & Andes, 2004; Collins et al., 1998; Collins et al., 2000; Culhane et al., 2002; Dole et al., 2004; Hobel & Culhane, 2003; Hogan, Njoroge, Durant, & Ferre, 2001; Lu & Chen, 2004; Phillips & Jackson, 2002). Racism can be defined as oppressive beliefs, attitudes, institutional arrangements and policies that differentially affect groups on the basis of skin colour and/or racial/ethnic history or background and can manifest at three different levels: institutional, interpersonal/personally mediated and internalized (Jones, 2000). Most studies on racism capture interpersonal/personally mediated racism on the basis of reported experiences of racism during daily interactions.

Institutional forms of racism are critical in understanding social stress beyond an individual's ability or willingness to report experiences of life stressors or racism. Institutional racism refers to the policies, norms and institutions that sustain racial divisions and inequality (Gotham, 2000; Jones, 2000). This can be the product of both overt and covert actions, resulting in a separation of racial groups, disinvestment in racially mixed or non-White communities and directing investment and resources into homogenous, all-White communities (Gotham, 2000; Jones, 2000). Residential redlining, the institutional practice of banks and other financial institutions denying loans to individuals and communities on the basis of race, captures a form of institutional racism (Hillier, 2003; Lacker, 1995). Residential segregation, the geographic separation of racial/ethnic groups, is deemed the result of institutionally racist practices such as residential redlining (Massey & Denton, 1993).

Racism, stress and residential environments

Neighbourhood and residential environments are critical for understanding potential sources of stress for some populations. Neighbourhoods and communities that experience high rates of crime, exposure to environmental toxins, lack of health resources, limited amounts

of fresh produce and healthy foods, inadequate and unsafe housing, and joblessness may be stress-inducing and have been associated with adverse health outcomes and unhealthy behaviours (Diez Roux, 2001; Greenberg & Schneider, 1994; Greenberg, Schneider, & Choi, 1994; Morland, Wing, Diez Roux, & Poole, 2002; Northridge, Stover, Rosenthal, & Sherard, 2003; Schulz et al., 2000; Williams & Collins, 2001). Adverse neighbourhood conditions tend to cluster in areas that are typically minority and low income as a result of institutional practices and redlining policies that reinforce geographic separation (Massey & Denton, 1993; Williams & Collins, 2001). Residential segregation in turn reinforces place-based and racial/ethnic inequities in health (White, Haas, & Williams, 2012). Understanding residential redlining and segregation is important because it influences proximity to important resources, including institutions such as schools, hospitals, child care facilities and labor markets (Reardon, 2006).

Residential redlining and segregation may also cause stress because of the differential exposure to hazards and access to health-promoting resources (Carr, 1999; Culhane & Elo, 2005; Gee & Payne-Sturges, 2004; Williams & Collins, 2001). For example, one study found that neighbourhood racial composition and poverty were associated with reported stress after accounting for other individual-level attributes (Schulz et al., 2008), whereas another study did not find an association between self-reported stress and a composite measure of several neighbourhood factors, including neighbourhood racial composition (Schempf, Strobino, & O'Campo, 2009). On the other hand, residential segregation may be protective, where some dimensions of segregation have been associated with African-American political empowerment, concentrated social support and improved birth outcomes (Bell, Zimmerman, Almgren, Mayer, & Huebner, 2006; Laveist, 1993; Pickett, Collins, Masi, & Wilkinson, 2005).

However, studies are limited in examining the influence of residential redlining and segregation as indications of the neighbourhood environment on self-reported stress (Diez Roux, 2001). Previous studies have not examined the various dimensions of racial residential segregation or residential redlining in association with reported stress among pregnant women or if the association differs by race (Matthews & Yang, 2010; Schulz et al., 2008; Seaton & Yip, 2009). Further investigation is needed to understand the specific types of neighbourhood factors that may cause stress, with the goal of trying to intervene and possibly build upon neighbourhood strengths, particularly for pregnant and childbearing women.

Purpose of the study

The purposes of this study were as follows: (1) to examine the racial/ethnic differences in residential redlining, segregation and self-reported stress among pregnant women and (2) to examine whether residential redlining and segregation are associated with self-reported stress. We hypothesized that non-Hispanic Black women would be the most likely to report stress and live in neighbourhoods with low levels of residential redlining (i.e. neighbourhoods where Blacks are more likely to be denied mortgage loans compared with Whites) and high levels of segregation compared with women of other racial/ethnic groups. We also hypothesized that residential redlining and segregation would be associated with

stress. We examine these questions among a diverse group of pregnant women in an urban area.

Methods

Data sources

This research was part of a larger study examining maternal stress, bacterial vaginosis and birth outcomes among pregnant women. The parent study was a Centers for Disease Control and Prevention-funded study conducted from 1999 to 2004 and included pregnant women enrolled at the time of their first prenatal clinic visit. Women were interviewed face-to-face using structured surveys. Inclusion criteria were singleton gestation, intrauterine pregnancy, less than 20 weeks gestation and English or Spanish speaking. The average gestational age at the time of recruitment was 14.8 weeks. Additional details about the original study are found elsewhere (Culhane et al., 2002; Culhane et al., 2001; Elo, Mykyta, Margolis, & Culhane, 2009). During the interview, the women's addresses were collected, geocoded and assigned census tracts. These census tracts were used to link with the Home Mortgage Disclosure Act (HMDA) data and the 2000 US Census. The sample for the parent study was 4880, and we excluded 228 cases that could not be successfully geocoded and linked with corresponding census tract information for a total of 4652 women.

The HMDA is an administrative database created by the Federal Reserve Board that collects yearly information from banks and other lending institutions providing mortgage loans. HMDA contains all loan dealings from financial institutions throughout the United State for a particular year and includes information about type and amount of loan, census tract of the property, loan disposition and characteristics of the applicant. We calculated redlining indices (Black–White inequities in mortgage lending) from the HMDA for years 1999–2004 (described in detail later).

We used the 2000 US Census to derive several measures for residential segregation and to determine the percentage black for each neighbourhood in which the pregnant women lived.

Neighbourhood definition

The smallest geographic unit included in the HMDA database is the census tract. As a result, neighbourhoods were defined as census tracts within Philadelphia, PA. The addresses of the pregnant women were geocoded and assigned a census tract based on the US 2000 Census boundaries. Out of the entire pregnant population, there were a total of 315 census tracts represented and an average of 13 women per census tract. The range of number of women per tract was 1–86 where only 5% of the census tracts had less than five women.

Measures

Residential redlining—Residential redlining refers to the institutional practice of discrimination in lending, and the term was coined to describe how banks and lenders would draw red lines around areas on appraisal maps where they refused to provide mortgage loans or provided loans with worse terms (Hillier, 2003). In this study, we use the term redlining to describe to the racial (Black–White) inequity in mortgage denial. The

redlining indices were derived from the HMDA data. An average of 16,527 loans per year was included in the HMDA database between 1999 and 2004 in the analytic sample in Philadelphia, Pennsylvania. For the measure of redlining in this study, we excluded the following: (1) incomplete applications that were not processed by lending institutions and therefore could not be part of a measure for loan disposition bias; (2) properties that are not owner-occupied; (3) home improvement loans; and (4) multi-family units (Gee, 2002). The measure only includes mortgage loans with information about the applicant's race and only those identified as Black or White race. We calculated a redlining index for each census tract represented in the study. We applied random-effects logistic regression models to produce an estimate of the Black–White difference (random effect for race for each census tract) in loan denial after controlling for individual applicant income, loan amount and sex. The final index was a measure of the Black–White difference in mortgage lending for each census tract in the study area. The index scores ranged from 0.31 to 6.82 with a mean score of 1.95 and a median score of 1.88. A score of 2.0 would indicate a neighbourhood (census tract) where the odds of loan denial among Blacks are twice the odds of loan denial among Whites after controlling for loan amount, income and sex of the applicant. A score or 1.0 would indicate no racial difference.

Residential segregation—Residential segregation can be generally defined as the degree to which two or more groups live separately from one another (Massey, 2000; Massey & Denton, 1993). The segregation measures used in this study were the index of dissimilarity, exposure index and isolation index. These measures were created using the 2000 US Census. The *index of dissimilarity* ranges from 0 to 1 and measures the proportion of minorities (e.g. Blacks) that would have to change their area of residence to achieve an even distribution of the population in census tracts or block groups. This index measures the level of evenness or differential distribution of groups across areal units (Massey & Denton, 1988). The *exposure index*, also known as the interaction index, ranges from 0 to 1 and measures the extent to which members of a minority group (e.g. Blacks) are exposed to members of a majority group (e.g. Whites) (Massey & Denton, 1988). The higher values indicate a greater degree of segregation. The *isolation index*, another measure of exposure, varies from 0 to 1 and describes the extent to which members of minority group X are only exposed to one another. Additional information about the calculations for these measurements is found elsewhere (Massey & Denton, 1988).

Stress—The participants were asked to complete a 14-item self-report Cohen Perceived Stress Scale (PSS-14), which measures the degree to which a respondent appraises stressful circumstances along dimensions of unpredictability, uncontrollability and overload (Cohen, Doyle, & Baum, 2006; Cohen et al., 1983). The PSS is a psychometrically validated stress scale that is suggested for examining the role of appraised stress in the aetiology of disease among community samples (Cohen et al., 1983). Respondents were asked how often they felt or thought something in the past month: 'You have felt that you were unable to control the important things in your life', 'You have felt nervous or "stressed" ' and 'You have felt that you were on top of things'. Participants' answers are based on a Likert scale to what degree the item relates to them (0 = *never*, 1 = *almost never*, 2 = *sometimes*, 3 = *fairly often* or 4 = *very often*). A final PSS-14 score was computed by reversing the scores on the seven

positive items and then summing across all 14 scale items where a higher score indicated more psychological stress (Cohen et al., 1983). We explored the factor structure of the PSS-14 using exploratory factor analysis and extracted one factor. The weighted eigenvalue was 6.1, which explained 74% of the variance. The scores in this sample ranged from 0 to 52 (median = 24). The Cronbach's alpha for this sample was 0.81. We maintained all items in the scale for the final score, and was a continuous variable for the analysis.

Covariates—We controlled for several covariates based on our conceptual model and previous studies (Culhane & Elo, 2005; Matthews & Yang, 2010; Schulz et al., 2008; Yang & Matthews, 2010). The participants were asked to identify their race, which also included an option of Hispanic ethnicity. The classifications included in this study are non-Hispanic (NH) White, non-Hispanic (NH) Black, Hispanic/Latina and Other (henceforth termed White, Black, Hispanic and Other). We also included age at interview as a continuous variable that was grand-mean centred for the analysis. Total household income was operationalized as income from jobs, public assistance, unemployment, Social Security, family/friends or other sources. This was a categorical variable where respondents chose an income range that best fit their circumstances. Education was categorized as less than high school, high school/General Educational Development (Canadian and American high school equivalency exam) or post-high school. Marital status was categorized as married/living as married or not married/not living as married. The number of previous live births served as a proxy for number of children and was categorized as 0, 1, 2 or 3+. The number of years in the neighbourhood was a continuous variable. Participants were asked about the amount of sleep and rest they obtained and had to select one of three options: (1) 'I am tired a lot of the time (*Tired*)', (2) 'I get regular sleep but usually start the day feeling not fully rested (*Some Rest*)' and (3) 'I get the sleep and rest I need, and when I need it (*Fully Rested*)'. This variable was included in the analysis as a categorical variable with three levels. Respondents were asked if they avoided going outside for safety reasons and responded to a scale of 0 (*Never*) to 4 (*All the Time*). Social support was assessed by asking if the respondent could lean on someone during a time of need (yes/no).

Statistical analyses

Firstly, we calculated frequencies and means of the neighbourhood variables, key covariates and stress. Secondly, we conducted a spearman correlation to examine the association between neighbourhood factors and stress. Next, we conducted linear regression models to examine the association between individual-level variables and stress. We then conducted multilevel (random-effects) linear regression models to determine the relationship between redlining, segregation and stress after adjusting for individual-level covariates. The multilevel models include two levels: the individual-level variables (level 1) and the neighbourhood-level variables (level 2). Multilevel modelling techniques take into account the contribution of neighbourhood factors over individual factors and account for any clustering by neighbourhood (i.e. census tract). We estimated the following multilevel models: (1) a null model to estimate the proportion variance attributable to census tract differences (i.e. intraclass correlation); (2) models of the unadjusted association between each neighbourhood factors and stress; and (3) models of the association between each neighbourhood factor and stress after adjustment for individual-level covariates.

Previous studies have found that the relationship between neighbourhood context and pregnancy outcomes differs by race (Messer, Kaufman, Dole, Savitz, & Laraia, 2006; O'Campo et al., 2008; Vinikoor-Imler, Messer, Evenson, & Laraia, 2011), so we hypothesized that neighbourhood-level redlining (institutional racism) would influence perceptions of stress among pregnant women differently by race. However, cross-level interactions of race by the various neighbourhood-level measures were not significant, so we did not stratify our analyses by race. There were changes in residential redlining over the study period (1999–2004) for the census tracts included in the study (results not shown). As a result, we matched the redlining indices for each tract on the basis of the year each woman entered the study. Consequently, redlining was included as a level 1 predictor. We grand-mean centred the redlining index and the segregation indices and examined redlining and segregation as continuous variables since alternative specifications did not improve model fit. Since the redlining and segregation indices were correlated (Table II), we entered each neighbourhood variable into the model separately. We used SAS version 9.2 (SAS Institute Inc. (Cary, NC)) to complete all analyses.

The Public Health-Nursing Institutional Review Board at the University of North Carolina-Chapel Hill approved the secondary analysis for this study.

Results

Descriptive results

Individual characteristics of the women and neighbourhood characteristics are included in Table I. The majority of the population included Black women (67%), and the mean age for the entire population was 24 years old, which was consistent across racial/ethnic groups. Approximately 20% of the women in the entire population made less than $5000 per year, and 43% had a high school education. The majority of the women said that they did not regularly feel fully rested, did not have safety concerns and had social support.

The mean stress score was highest among Hispanic women, and the mean redlining score was highest among Black women compared with any other racial/ethnic group. The mean index of the segregation index of dissimilarity was 0.4 for the entire pregnant population, which is significantly smaller than the indices reported for the population of Philadelphia (Massey, 2000). Overall, Black women were more likely to live in segregated neighbourhoods compared with any other racial/ethnic group as measured by all segregation indices. Exposure segregation and redlining was positively associated with reported stress, and all other segregation indices were inversely associated with reported stress (Table II).

Multivariable results

Women were less likely to report stress if they self-identified as Black, were older, of higher income, had a lower number of previous live births, had more number of years in neighbourhood, had more rest and had less reported safety concerns (Table III). Women with no high school education and no social support were more likely to report stress. Redlining was not associated with stress after adjusting for individual covariates (Table IV). However, the segregation measure percentage black was inversely associated with stress

after adjustment for individual-level covariates. There was no association between stress and the other segregation measures after adjustment for individual-level covariates.

Discussion

In this study, we examined whether residential redlining and segregation were associated with self-reported stress among a diverse population of pregnant women. Although the majority of the overall population lived in redlined neighbourhoods, Black women were slightly more likely to live in redlined neighbourhoods compared with all other racial/ethnic groups. We expected the opposite because redlined areas were hypothesized to be areas that typically excluded Blacks. This finding could be due to areas that exclude Blacks from obtaining mortgage loans in order to own property but may include a significant portion of Black residents who may not be in the process of obtaining loans during the study period or may already own their home, and who may rent. We could not control for these factors in the present study. Black women were more likely to live in segregated neighbourhoods compared with women of other racial/ethnic groups as measured by percentage black in the neighbourhood, exposure index and isolation index, which is supported by previous work (Massey & Denton, 1993).

Hispanic women were more likely to report stress compared with women of other racial/ethnic groups. Although there were statistically significant differences, the actual differences in stress scores across racial/ethnic groups were slight. It is plausible that the Hispanic women and non-Hispanic White women in this study are more likely than non-Hispanic Black women to appraise their stress as measured by the PSS-14.

We found that neighbourhood percentage black was inversely associated with reported stress, but redlining or any of the other segregation measures were not significantly associated with stress after adjustment for individual covariates. The percentage black captures a dimension of segregation where Blacks may be more likely to come in contact with other Blacks and less likely to come in contact with other racial/ethnic groups. This may be protective for some populations and is related to less reported stress among this pregnant population. We hypothesized that redlined areas may tend to exclude minority groups, but the minority groups living in these neighbourhoods may report stress. Prior studies examining the relationship between neighbourhood racial composition and reported stress among non-pregnant populations were mixed, where one study found a positive relationship (Schulz et al., 2008), whereas another study did not find an association (Schempf et al., 2009).

In race-stratified ancillary analyses, we found that redlining was actually associated with stress for Black and Hispanic women and inversely associated with stress for White women (results not shown). In additional ancillary analyses, we examined whether these redlined areas tended to have a higher composition of White residents, but this was not the case. We actually found that many of the redlined areas ranged in their racial composition.

There were some limitations to this study. Since the cohort in this study is a clinic-based sample, pregnant women may be excluded who do not seek prenatal care or have access

to prenatal care. To address this issue, participants were recruited from both public and private clinics for a range of socioeconomic backgrounds. There may be limitations in the self-reported stress scale applied to this diverse, pregnant population. However, the stress scale used in this study was initially validated among predominantly college samples and also applied among other populations (Cohen et al., 1983). The study takes into account the neighbourhoods in which the pregnant women live, but it does not capture all aspects that may influence pregnant women's stress levels including workplace stress. Finally, the indices generated from the HMDA data do not take into account the influence of other mortgage disposition characteristics such as employment and creditworthiness, influencing how redlining can be characterized in a particular neighbourhood (Lacker, 1995; Mendez, Hogan, & Culhane, 2011). However, previous studies have found that after obtaining additional information on other economic characteristics such as wealth, debt and creditworthiness not captured in HMDA, there were still racial inequities in loan denials (Lacker, 1995; Munnell, Browne, & McEneaney, 1992).

Despite some of the limitations, this study provides an analysis of residential characteristics and institutional racism to understand the experiences of women during pregnancy. The measures employed in this study may capture an experience that may not be appraised or reported by individuals, but may have an influence on the participants' pregnancies, their levels of stress, and subsequent birth and health outcomes. Additionally, the residential measures included in this study emphasize the complex nature of institutional racism, segregation and the neighbourhood context, and the implications for the health of pregnant women. Although we did not find an association between redlining and reported stress among this population, future studies of neighbourhood social factors and their relationship to stress can help bring forth a better understanding of how external social factors may influence health and stress for certain populations. Finally, future studies should also consider how both the neighbourhood social and physical environment may influence stress and health among various populations.

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Table I.

Selected individual and neighbourhood characteristics for all women and by race/ethnicity

Characteristic	All women	Black	White	Latina/Hispanic	Other[a]	*p*-value[b]
Individual characteristics						
Race/ethnicity, *N*(%)[c]	4652	3081 (66.4)	421 (9.1)	1001 (21.6)	136 (2.9)	—
Age, mean (SD)	24.18 (5.7)	24.24 (5.9)	23.85 (5.6)	24.01 (5.2)	25.19 (6.5)	0.08
Total household income, *N*(%)						
Under $5000	887 (21.2)	453 (16.4)	40 (11.4)	369 (39.4)	22 (19.0)	<0.001
$5000–9999	618 (14.8)	399 (14.4)	39 (11.1)	162 (17.3)	16 (13.8)	
$10,000–19,999	1059 (25.3)	707 (25.5)	97 (27.7)	213 (22.7)	41 (35.3)	
$20,000–29,999	835 (20.0)	620 (22.4)	75 (21.4)	114 (12.2)	24 (20.7)	
$30,000–39,999	456 (10.9)	347 (12.5)	45 (12.9)	55 (5.9)	8 (6.9)	
$40,000+	325 (7.8)	242 (8.7)	54 (15.4)	24 (2.6)	5 (4.3)	
Education, *N*(%)						
Less than HS	1750 (37.7)	1042 (33.9)	167 (39.7)	493 (49.4)	46 (33.8)	<0.001
HS grad/GED	2020 (43.6)	1440 (46.8)	184 (43.7)	340 (34.1)	53 (39.0)	
Post-HS	868 (18.7)	596 (19.4)	70 (16.6)	165 (16.5)	37 (27.2)	
Marital status, *N*(%)						
Married/cohabiting	1167 (25.1)	527 (17.1)	108 (25.7)	465 (46.5)	64 (47.1)	<0.001
Not married	3485 (74.9)	2254 (82.9)	313 (74.4)	536 (53.6)	72 (52.9)	
Previous live births, *N*(%)						
0	1851 (42.1)	1240 (42.1)	197 (48.6)	341 (38.0)	67 (50.0)	0.02
1	1270 (28.9)	812 (27.6)	121 (29.9)	300 (33.4)	34 (25.4)	
2	710 (16.2)	481 (16.3)	51 (12.6)	157 (17.5)	19 (14.2)	
3+	565 (12.9)	414 (14.1)	36 (8.9)	99 (11.0)	14 (10.4)	
Number of years in neighbourhood, *M*(SD)	6.69 (8.1)	7.95 (8.7)	6.94 (8.0)	2.99 (5.0)	4.11 (5.2)	<0.0001
Sleep/rest, *N*(%)						
Tired	1306 (28.3)	892 (29.1)	139 (33.4)	237 (24.0)	36 (26.9)	0.15
Some rest	2330 (50.5)	1541 (50.3)	208 (50.0)	526 (53.3)	47 (35.1)	
Fully rested	976 (21.2)	630 (20.6)	I69 (16.6)	224 (22.7)	51 (38.1)	
Safety concerns, *N*(%)						

Characteristic	All women	Black	White	Latina/Hispanic	Other[a]	*p*-value[b]
Never	3186 (68.8)	2082 (67.8)	323 (70.0)	675 (67.6)	100 (73.5)	0.02
All the time	72 (1.6)	50 (1.6)	3 (0.7)	18 (1.8)	1 (0.7)	
Social support, *N*(%)						
Yes	4388 (94.8)	2918 (95.0)	406 (96.7)	931 (93.5)	128 (94.1)	0.75
Stress (PSS-14), *M*(SD)	23.03 (7.65)	22.52 (7.94)	23.83 (7.72)	24.30 (6.47)	22.67 (7.70)	<0.0001
Neighbourhood characteristics						
Redlining, *M*(SD)	1.95 (0.75)	1.99 (0.75)	1.93 (0.84)	1.85 (0.71)	1.90 (0.73)	<0.0001
Residential segregation:						
Percentage black, *M*(SD)	0.58 (0.36)	0.74 (0.29)	0.17 (0.23)	0.28 (0.22)	0.40 (0.33)	<0.0001
Black dissimilarity index, *M*(SD)	0.40 (0.14)	0.40 (0.12)	0.49 (0.17)	0.36 (0.13)	0.43 (0.16)	<0.0001
Black isolation index, *M*(SD)	0.63 (0.32)	0.78 (0.26)	0.27 (0.23)	0.36 (0.22)	0.48 (0.30)	<0.0001
Black exposure index, *M*(SD)	0.18 (0.24)	0.11 (0.18)	0.53 (0.25)	0.23 (0.24)	0.32 (0.28)	<0.0001

GED, General Educational Development; PSS-14, 14-item self-report Cohen Perceived Stress Scale.

[a]Asian and other racial/ethnic groups.

[b]For comparison across racial/ethnic groups; *F* test for continuous variables and X^2 for categorical variables.

[c]Thirteen missing for race/ethnicity.

Table II.

Spearman correlation of neighbourhood-level institutional racism and stress (PSS-14) for all women

	Redlining	Percentage black	Black dissimilarity	Black isolation	Black exposure
Stress	0.01	−0.08***	−0.03	−0.09***	0.06**
Redlining		0.12***	0.27***	0.15***	−0.16***
Percentage Black	0.12***		0.04*	0.99***	−0.88***
Black dissimilarity	0.27***	0.04*		0.14***	−0.03*
Black isolation	0.15***	0.99***	0.14***		−0.88***

* $p \leq 0.05$;

** $p \leq 0.01$;

*** $p \leq 0.001$.

Table III.

Coefficients from fixed-effects linear models for reports of stress

Individual characteristics	Stress
Intercept	28.1 (1.2)
Race/ethnicity (White)	
Black	−1.2 (0.5)**
Latina/Hispanic	0.4 (0.5)
Other	0.4 (0.9)
Age	−0.007 (0.03)***
Marital status (not married)	
Married/cohabiting	−1.3 (0.3)***
Education (post-HS)	
No HS	1.4 (0.4)***
HS grad/GED	0.6 (0.4)
Total household income (under $5000)	
$5000–9999	−0.7 (0.4)
$10,000–19,999	−1.3 (0.4)***
$20,000–29,999	−0.5 (0.4)
$30,000–39,999	−1.6 (0.5)**
$40,000+	0.2 (0.5)
Previous live births (3+)	
0	−1.2 (0.5)*
1	−0.8 (0.4)
2	−0.008 (0.5)
Number years in neighbourhood	−0.1 (0.02)***
Sleep/rest (tired)	
Some rest	−2.5 (0.3)***
Fully rested	−4.6 (0.4)***
Safety concerns (all the time)	
Never	−3.7 (1.0)***
Rarely	−3.3 (1.0)***
Sometimes	−2.7 (1.0)**
Often	−1.5 (1.2)
Social support (yes)	
No	1.4 (0.6)*
Overall r^2	0.10

Standard errors are in parentheses. Significance tests are based on the associations between individual-level variables and stress for all women and by race/ethnicity.

GED, General Educational Development.

*$p \leq 0.05$;

**$p \leq 0.01$;

***$p \leq 0.001$.

Table IV.

Coefficients from multilevel (random-effects) linear adjusted models for reports of stress

Neighbourhood-level variables	Stress
Residential redlining	
Intercept	26.3 (1.5)
Estimate	0.37 (0.2)
Residential segregation measures	
Percentage black	
Intercept	26.3 (1.5)
Estimate	−1.1 (0.5) *
Index of dissimilarity	
Intercept	26.6 (1.5)
Estimate	−0.8 (1.1)
Isolation index	
Intercept	29.6 (1.1)
Estimate	−1.0 (0.6)
Exposure index	
Intercept	29.7 (1.1)
Estimate	0.6 (0.7)
Between group (neighbourhood) variance	1.3
Within group (neighbourhood) variance	57.2
ICC	0.02

Standard errors are in parentheses. Each neighbourhood-level variable is entered into the model separately and adjusted for race, age, marital status, education, income, previous live births, number of years in neighbourhood, sleep/rest, safety concerns and social support. ICC, intraclass correlation from null model based on between group and within group variances: [(between group variance) / (between group + within group variances)].

* $p \leq 0.05$;

** $p \leq 0.01$;

*** $p \leq 0.001$.