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Neighborhood Social Cohesion and Inflammatory Biomarkers in African American and White Adults

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Epidemiology

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Abstract

Neighborhood Social Cohesion and Inflammatory Biomarkers in African American and White Adults

By Vanessa Neergheen

Introduction: Social cohesion is a positive neighborhood characteristic defined by feelings of connectedness and solidarity within a community. Studies have found significant associations between social cohesion and cardiovascular disease (CVD) risk factors and outcomes. Inflammation is one potential physiological pathway linking social cohesion to CVD development, but few studies have evaluated the relationship between social cohesion and inflammatory biomarkers. Prior research has also established that race and gender can modify the effects of neighborhood features, including social cohesion, on CVD risk factors and outcomes.

Methods: Data from the Morehouse and Emory Team Up to Eliminate Health Disparities (META-Health) Study were used to examine the association between social cohesion and inflammatory biomarkers (interleukin-6 (IL-6) and C-reactive protein (CRP)) among African American (n=259) and White (n=259) adults from the Atlanta metropolitan area. Social cohesion was assessed using the social cohesion subscale from the Neighborhood Health Questionnaire. Multivariable linear regression analyses were conducted, controlling for demographic, clinical, behavioral, and psychosocial factors sequentially. Interaction by race and gender was also considered.

Results: In the models adjusted for age, race, gender, and education, social cohesion was significantly associated with IL-6 (β=-0.06, p=0.03) and there was a significant race by social cohesion interaction (β=-0.12, p=0.04) and marginally significant race by gender by social cohesion interaction (β=-0.21, p=0.09). Race-stratified models controlling for age, gender, and education revealed a significant association between social cohesion and IL-6 in African Americans (β=-0.11, p=0.01), but not Whites (β=0.01, p=0.91). For African American women, all models depicted a significant association between social cohesion and IL-6, including the fully adjusted model (β=-0.16, p=0.001). None of the models illustrated a significant relationship for White women, White men, or African American men. The only significant association between social cohesion and CRP was found for women in crude models; this association was non-significant after adjustment.

Conclusion: The effect of social cohesion on IL-6 is modified by race and gender, with the strongest association emerging for African American women. Although the pathways through which social cohesion impacts inflammation remain unclear, it is possible that for African American women social cohesion manifests through neighborhood networks of fictive kin.

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Introduction

A strong and consistent body of research has established the importance of neighborhood context for cardiovascular health (1). Studies have documented linkages between a range of neighborhood factors, such as neighborhood disadvantage (2, 3), violent crime (4), unemployment (4), social disorganization (5), and cardiovascular health and disease. However, most of these studies have focused on how negative neighborhood characteristics detrimentally impact markers of cardiovascular health, with limited attention to the effects of positive, or protective, aspects of "place" on health. One positive neighborhood factor that may influence cardiovascular health is social cohesion. Social cohesion is defined as feelings of connectedness and solidarity experienced by neighbors, members of a community, or other societal groups (6). A socially cohesive neighborhood is characterized by the presence of strong social bonds that are believed to develop when neighbors share trust and norms of reciprocity with one another (6). The health effects of social cohesion were first explored by Émile Durkheim in his seminal work on the social causes of suicide, which posited that the absence of social integration increases the risk of suicide (7). Epidemiological evidence also supports the proposed relationship between social cohesion and health, finding that individuals who are more socially integrated exhibit decreased risk of mortality (8-10).

Social cohesion has also been significantly associated with cardiovascular disease (CVD) risk factors (11-15) and outcomes (16, 17). Cohesiveness has been found to improve health behaviors, such as increasing physical activity (14, 15) and decreasing smoking (11, 14), and to protect against chronic stressors (18, 19). In the early 2000s, physiological pathways were proposed as a mechanism through which social networks may impact health (20), yet researchers have only recently begun to examine physiological pathways linking social cohesion to CVD risk factors (12, 21-24). Inflammation is one plausible physiological mechanism that might link social cohesion to later CVD. Interleukin-6 (IL-6) and C-reactive protein (CRP), in particular, are two inflammatory biomarkers with strong and consistent linkages with incident CVD (25, 26). However, relatively few studies have assessed the effect of neighborhood characteristics, particularly aspects of the neighborhood social

environment, on these outcomes. Among studies examining neighborhood social interactions, a significant association between perceived neighborhood safety and IL-6 has been reported (24), while in at least two other studies higher crime levels were associated with elevated CRP (27, 28). With respect to social cohesion, in a study of relatively young, healthy Brazilian adults who migrated to metropolitan Boston, Holmes and Marcelli found that higher reports of social cohesion were associated with lower levels of inflammation measured via CRP (29). However, to date, there is limited research examining the association between neighborhood social cohesion and inflammation in population-based samples.

The current analysis was designed to examine the association between social cohesion and inflammatory biomarkers in an urban cohort of African American and White women and men. We were particularly interested in determining whether associations differed by race and gender. In the US, African Americans and Whites live in disparate neighborhood contexts (30). There are known Black-White differences in neighborhood quality, with poorer, segregated African American neighborhoods containing a larger number of abandoned buildings and grounds, insufficient municipal services and amenities, substandard housing quality, heightened levels of noise, and elevated quantities of pollutants and allergens (30). Studies have found that associations between neighborhood characteristics and CVD risk factors also varied by race, with one study finding a stronger association for African Americans when considering the role of neighborhood crime (31) and another identifying a greater effect for Whites when assessing the impact of neighborhood racial composition (32). Similarly, researchers have observed gender differences in the associations between neighborhood factors and CVD. Studies have found that neighborhood characteristics such as excessive noise, violence, and objectively reported crime may affect CVD risk factors among women, but not among men (22, 31).

The association between social cohesion, specifically, and CVD risk factors and outcomes may also differ by race and gender. Although findings have been mixed (33-35), at least two studies assessing the health impacts of social cohesion support a differential effect by race, finding that social

cohesion was protective against stroke and cardiovascular mortality for Whites, but not African Americans (34, 35). Prior research has also demonstrated that higher social cohesion reduced the odds of hypertension, coronary artery calcification, obesity, and depression among women, but not among men (12, 13, 36, 37). Furthermore, a recent study from the Jackson Heart cohort focused on a less traditional risk factor for CVD, cumulative biological risk (CBR) (38, 39), finding that neighborhood disadvantage and social cohesion were jointly associated with CBR in African American men, but not African American women (21). Thus, previous findings that the effects of neighborhood factors, including social cohesion, may vary across race and gender suggest that interaction between social cohesion and these demographic variables warrants further consideration.

Using data from the Morehouse and Emory Team Up to Eliminate Health Disparities (META-Health) Study, we aimed to examine cross-sectional associations between neighborhood social cohesion and two inflammatory biomarkers, IL-6 and CRP. We hypothesized that higher social cohesion would be associated with lower levels of both inflammatory biomarkers. We then considered whether race and gender modified this effect. Because some studies have found significant associations between social cohesion and CVD risk in Whites and not African Americans (34, 35), while others have identified significant associations among African Americans (21), we did not have specific hypotheses about the direction of the race by social cohesion interaction. However, findings have been relatively consistent for gender differences (12, 13, 36, 37), thus we hypothesized that associations between social cohesion and inflammation would be stronger for women, compared to men, in our cohort. We also assessed whether demographic, clinical, behavioral, and psychosocial characteristics contributed to the associations between social cohesion and inflammation.

Methods

Study Sample

Between 2005 and 2010, the Morehouse and Emory Team Up to Eliminate Health Disparities (META-Health) Study recruited residents from the metropolitan Atlanta area for a two-stage cross-sectional study of traditional and psychosocial CVD risk factors. The first stage sampled

African American and White adults 30 to 65 years old (n=3,391) through a random digit dialing survey, and a subset of participants (n=753) were invited to an in-person study visit at the Emory or Morehouse School of Medicine. During these visits, demographic and anthropometric data was collected and the Neighborhood Health Questionnaire was administered to assess participants' perceptions of their neighborhood environment. Individuals who reported recent acute illness, including cold-like symptoms or pain, and pregnant women were excluded from the study. The Emory University and Morehouse University Institutional Review Committees approved this study, and all participants provided informed consent.

Measurement of Interleukin-6 and C-Reactive Protein

Inflammatory biomarkers were measured from plasma frozen at -70°C. IL-6 was quantified by ultrasensitive ELISA (R&D Systems, Minneapolis, Minnesota) and high sensitivity CRP by immunonephelometry (Siemens/Dade Behring).

Measurement of Social Cohesion

Social cohesion was assessed via four items drawn from the Neighborhood Health Questionnaire (40) based on prior work on neighborhood contexts (13, 14, 21, 23, 24, 36). The social cohesion items were originally developed by Sampson and colleagues as part of the Chicago Project of Human Development and have been previously validated within multiethnic cohorts (41, 42). Items inquire whether neighbors are willing to help one another, get along, trust each other, and share the same values (40). Responses are scored using a five point Likert scale ("Strongly Agree" to "Strongly Disagree", with an additional response option of "Don't Know/Not Sure"). An overall score for social cohesion was created by averaging the individual items. Individual items marked "Don't Know/Not Sure" were removed from the overall calculation and scores were assigned a missing value if three or more items were answered "Don't Know/Not Sure". For both the individual items and overall score, higher scores indicated greater perceived social cohesion.

Measurement of Covariates

Demographic (age, race, gender, education), clinical (body mass index (BMI), triglycerides, high-density lipoprotein cholesterol (HDL-C), statin use), behavioral (history of smoking, leisure time physical activity, sleep quality), and psychosocial (depressive symptoms) characteristics were selected as baseline covariates based on previous literature and the potential for these factors to affect inflammatory biomarker measurement (24, 43).

Demographics

Race was self-reported as "Black or African-American" or "White or Caucasian". Gender was also self-reported as "Male" or "Female". Education was considered the highest grade attained and was categorized as high school or less (encompassing elementary school, some high school, and high school/General Equivalency Diploma (GED)), some college, and college and more.

Clinical

At the study visit, participants' height and weight were measured and BMI (kg/m^2) was calculated. Subjects fasted for 12 hours prior to the study visit, during which venous blood was collected in sodium heparin tubes. Spectrophotometry performed on blood specimens was used to measure serum levels of triglycerides and HDL-C. Finally, statin use was distinguished as users versus non-users.

Behavioral

A standardized 11-item questionnaire from the biracial Atherosclerosis Risk in Communities (ARIC) Study was utilized to evaluate self-reported smoking history (44, 45), which was dichotomized for analyses as current smoker or former/never smoker. The self-administered Baecke physical activity questionnaire was used to obtain summary scores for sport and non-sport physical activity during leisure time (46). Following the methodology of prior studies, the eight items assessing sport activity were added to the items measuring non-sport activity to create a 16-item summary Baecke leisure time activity index, with higher scores signifying greater physical activity during leisure time (47). The Baecke questionnaire has been validated (48, 49) and previously employed to measure

physical activity in both African Americans and Whites (50). Study subjects also completed the 19-item Pittsburgh Sleep Quality Index (PSQI), which has been validated in biracial samples and inquires about overall sleep quality and sleep-related symptoms from the previous month (51, 52). Throughout analyses, the total PSQI score was treated as a continuous variable, though scores above five indicate poor sleep quality.

Psychosocial

The 21-item Beck Depression Inventory (BDI)-II was self-administered to assess depressive symptoms experienced over the past two weeks. Although the BDI-II has been more frequently validated within White populations, small studies have validated this measure among African Americans as well (53, 54). The total BDI-II score was considered as a continuous variable ranging from 0 to 63. Higher scores were indicative of more depressive symptoms, with scores 0-13 representing minimal to no depression, 14-19 mild depression, 20-28 moderate depression, and 29-63 severe depression.

Statistical Methods

Descriptive statistics on variables of interest were summarized as proportions for categorical variables and as means±SD for continuous variables. Because we were ultimately interested in examining associations by both race and gender, racial differences were tested within gender groups. Within gender groups, categorical and continuous variables were compared across race via chi-square tests and unpaired two-sample t-tests, respectively.

Multivariable linear regression analyses were conducted to examine the association between social cohesion and the inflammatory biomarkers, adjusting for demographics and relevant covariates. Due to the skewed distribution of IL-6 and CRP, natural log transformed levels were used throughout all analyses. For each set of analyses, four models were considered: Model 1 contained demographic variables, namely age, race, gender, and education; Model 2 added clinical terms, specifically BMI, triglycerides, HDL-C, and statin use; Model 3 added behavioral factors including history of smoking, leisure time physical activity, and sleep quality; and Model 4 added psychosocial

depressive symptoms. To determine whether associations varied by race, gender, or race and gender simultaneously, social cohesion*race, social cohesion*gender, and social cohesion*race*gender interaction terms were tested within the full sample. Models were stratified when significant interactions were observed. Two-tailed tests performed at $\alpha=0.05$ were utilized to determine statistical significance. Statistical analyses were performed using SAS 9.4 (SAS Institute, Cary NC, USA).

Results

Participant Characteristics

Table 1 summarizes demographic, clinical, behavioral, psychosocial, neighborhood, and inflammatory variables for women and men separately, by race. For both women and men, African Americans were less likely than Whites to have completed college (35.0% compared to 53.6% for women; 25.3% compared to 38.5% for men), reported lower social cohesion scores, and had lower levels of triglycerides. Among women, African American women had higher BMIs, elevated levels of CRP, less leisure time physical activity, and poorer sleep quality than their White counterparts. Among men, African American men were younger and had higher levels of HDL-C than White men; however, there were no racial differences in CRP levels. There were also no racial differences in IL-6 levels among women or men.

Social Cohesion and Inflammatory Biomarkers

In the multivariable linear regression models adjusted for age, race, gender, and education, the association between social cohesion and IL-6 was significant ($\beta=-0.06$, $p=0.03$) and there was a significant race by social cohesion interaction ($\beta=-0.12$, $p=0.04$) and a marginally significant race by gender by social cohesion interaction ($\beta=-0.21$, $p=0.09$). The gender by social cohesion interaction was non-significant ($\beta=-0.07$, $p=0.23$). Race-stratified models controlling for age, gender, and education revealed a significant association between social cohesion and IL-6 in African Americans ($\beta=-0.11$, $p=0.01$), but not Whites ($\beta=0.01$, $p=0.91$) (Table 2). In African Americans, the association between social cohesion and IL-6 remained significant after adjusting for clinical variables, such as

BMI, triglycerides, HDL-C, and statin use (Model 2, Table 2); behavioral factors, including history of smoking, leisure time physical activity, and sleep quality (Model 3, Table 2); and psychosocial depressive symptoms (Model 4, Table 2).

Because we observed a marginal three-way race by gender by social cohesion interaction, we ran additional analyses stratified by the four race-gender groups. As seen in Table 3, in models adjusted for age and education, there was a significant association between social cohesion and IL-6 in African American women only, and the association remained significant after adjusting for BMI, triglycerides, HDL-C, statin use, smoking history, leisure time physical activity, sleep quality, and depressive symptoms (β=-0.16, p=0.001). There were no significant associations observed between social cohesion and IL-6 in White women, White men, or African American men in minimally or fully adjusted models (Table 3). Additionally, the three-way interaction was statistically significant in fully adjusted models as well (β=-0.27, p=0.03).

Social cohesion was not significantly associated with CRP in minimally or fully adjusted models, though in models controlling for age, race, gender, and education there was significant gender by social cohesion interaction (β=-0.21, p=0.02). However, there was no significant race by social cohesion (β=-0.02, p=0.78) or race by gender by social cohesion interaction (β=-0.13, p=0.49). Upon stratification by gender, the only significant association detected between social cohesion and CRP was for the unadjusted female model (β=-0.08, p=0.04), though this association was attenuated after including additional covariates.

Discussion

In this bi-racial, community based sample, we found that social cohesion was associated with IL-6 in African American, but not White, middle aged adults. The association among African Americans persisted following adjustment for demographic, clinical, behavioral, and psychosocial variables. Although African Americans reported lower levels of social cohesion than Whites, the significant race by social cohesion interaction that we identified indicates that social cohesion may be a more impactful neighborhood factor for African Americans relative to Whites. Our findings also

demonstrate that the association between social cohesion and IL-6 may vary by race-gender group. We detected a marginally significant race by gender by social cohesion interaction and found consistently larger cohesion parameter estimates for African American women, relative to other groups, which suggests they may be driving the association between social cohesion and IL-6 among African Americans.

To our knowledge, only one prior study has demonstrated an association between higher social cohesion and inflammation, though that study did not consider IL-6 and was limited in scope to a sample of young, healthy Brazilian adults born outside the US (29). Nonetheless, our results align with prior findings and our hypothesis that the effect of social cohesion on CVD risk factors may be stronger for women than for men (12, 13, 36, 37), at least among African Americans. However, our results contradict previous findings on racial differences in the association between social cohesion and CVD risk. At least two prior studies have found that social cohesion is protective against stroke and cardiovascular mortality among Whites, but not African Americans (34, 35). Although our findings do not correspond to these results, both of those studies were conducted among adults living in Chicago, so it is possible that neighborhood effects impact health differently for African Americans residing in the Midwest and African Americans living in the South. Research demonstrates that across the US, Black-White segregation is most prominent in metropolitan areas in the Northeast and Midwest, indicating that African Americans living in the Midwest may experience greater disadvantage than Southern African Americans (55).

Social cohesion may be especially influential for African Americans in Southern American states due to its relationship to agency and collective efficacy. Throughout the US, and especially in the South, African Americans have historically engaged in collective action in response to structural and economic challenges (56). It is plausible that the shared experience of these adversities also evokes heightened group identification, and again demonstrates why social cohesion, and the implicit sentiments of connectedness and solidarity, may be a prominent force in the lives of African Americans (57, 58). Our findings suggest that the ongoing necessity for collective action and elevated

group identification may contribute to the greater role of social cohesion in positively impacting health among African Americans, but not Whites.

Among African Americans, associations were stronger for African American women than for African American men (22, 59). Sociological research on women's relationships in the neighborhood setting offers additional insight into the heightened associations we observed for African American women. Research indicates that, in comparison to men, women are more integrated in their neighborhoods and invested in their relationships with others. Studies on neighborhood networks demonstrate that women have larger networks, know more of their neighbors by name, and talk or visit with neighbors more frequently (60). In addition to maintaining larger social networks, women are also more emotionally involved in the life events occurring within their networks (61). For African American women specifically, neighborhood relationships may operate through fictive kin networks. In African American communities, fictive kin are individuals who are not related by blood or marriage, such as neighbors, but are assigned kinship status (62). Implicit in kinship status is intensified mutual obligation, with expectations for fictive kin to engage in the duties typically assigned to extended family, such as providing childcare, transportation, financial assistance, or emotional support (62). Given the salience of neighborhood relationships in women's lives, it is unsurprising that African American women are more likely to report having fictive kin relations than African American men (62). It is possible that for African American women, neighborhood fictive kin networks jointly embody the effects of African American group identification and female social network integration. This phenomenon, unique to African American women's intersectional identity, may explain the heightened effect of social cohesion we observed among African American women, and the lack of an association detected for African American men or White women.

The exact pathways through which social cohesion impacts inflammation are unclear. For African American women in this study, the association between social cohesion and IL-6 persisted even following adjustment for age, education, BMI, triglycerides, HDL-C, statin use, smoking

history, leisure time physical activity, sleep quality, and depressive symptoms. It is possible that social cohesion experienced at the neighborhood level protects against excessive hypothalamic-pituitary-adrenal (HPA) axis activity, which can drive cortisol elevations and inflammatory responses (63). For example, in a study of neighborhood characteristics and features of the diurnal cortisol curve, higher social cohesion was associated with increased cortisol upon awakening, steeper early decline, and steeper wake-to-bed slope (23). Furthermore, another study examining associations between neighborhood factors and cortisol profiles also identified a relationship between lower social cohesion and decreased cortisol upon awakening (64).

We did not detect significant associations between social cohesion and CRP. Although Holmes and Marcelli did observe a significant relationship between social cohesion and CRP, they did not consider levels of IL-6 as an outcome measure (29). Furthermore, their study was conducted in the metropolitan Boston area using a sample of relatively healthy Brazilian adults born outside the US. In their study, there was a larger percentage of male participants (59% of subjects compared to 39% of subjects in our study). Additionally, their study subjects were younger (34±10 years) and had lower BMIs (25.8±3.7 kg/m^2). They also had substantially lower levels of CRP (2.5±3.4 mg/L) than the African American participants in our study.

Limitations

Our study is not without limitations. Primarily, the cross-sectional nature of this study precludes causal inference. Longitudinal research on the relationship between social cohesion and inflammation will be necessary to determine causality and to establish the mechanisms through which social cohesion impacts inflammation. Additionally, social cohesion was assessed based on residents' perceptions rather than through objective measurement. Surveying residents living in the same neighborhoods as study subjects could yield more objective measures of neighborhood characteristics, though it is possible that the surveyed residents and study subjects would not share the same conceptualization of neighborhood boundaries. Furthermore, although demographic, clinical, behavioral, and psychosocial covariates were controlled for, residual confounding could exist.

Finally, although the META-Health study sample is population-based, it consists of non-Hispanic White and non-Hispanic African American individuals residing in four Georgia counties. The results of this study may therefore not be generalizable to other racial/ethnic groups or populations living in other areas.

Conclusion

In this sample of African American and White adults from the metropolitan Atlanta area, neighborhood social cohesion was associated with IL-6 among African Americans, with the strongest and most robust associations observed in African American women. This study adds to the neighborhood effects literature by considering a positive neighborhood characteristic, as previous research has largely concentrated on negative neighborhood factors. These findings also expand upon the current literature on neighborhood context and cardiovascular health by demonstrating that inflammation represents an additional CVD risk factor that may be impacted by social neighborhood exposures. Future interventions aiming to reduce CVD among African American women might consider incorporating activities designed to foster neighborhood social cohesion.

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Tables

Table 1. Participant Characteristics by Race and Gender.

	White Women (n=155)	**African American Women** (n=160)	**p**	**White Men** (n=104)	**African American Men** (n=99)	**p**
Age (years)	52±9	50±9	0.10	53±8	49±9	0.002
Education			<0.0001			0.001
Elementary, high school, or GED	7 (4.5%)	39 (24.4%)		7 (6.7%)	21 (21.2%)	
Some college	25 (16.1%)	38 (23.8%)		11 (10.6%)	22 (22.2%)	
College graduate	83 (53.6%)	56 (35.0%)		40 (38.5%)	25 (25.3%)	
BMI (kg/m²)	27.5±6.8	32.1±8.2	<0.0001	29.5±5.5	30.4±6.9	0.28
Triglycerides (mg/dL)	123.2±69.3	96.8±37.7	<0.0001	155.9±89.2	104.5±45.6	<0.0001
HDL-C (mg/dL)	64.5±18.7	61.4±14.1	0.11	47.9±13.9	51.8±13.1	0.04
Statin Use	12 (7.7%)	19 (11.9%)	0.46	15 (14.4%)	11 (11.1%)	0.28
Current Smoker	11 (7.1%)	23 (14.4%)	0.07	9 (8.7%)	15 (15.2%)	0.31
Leisure PA	6.6±1.4	5.9±1.3	0.0001	6.4±1.4	6.2±1.6	0.42
PSQI	5.4±3.3	6.8±4.1	0.002	5.5±3.6	6.4±4.0	0.08
BDI-II	8.3±7.3	9.0±9.0	0.46	7.8±9.6	8.8±7.6	0.40
NBH Social Cohesion	3.8±0.7	3.6±0.7	0.003	3.7±0.6	3.5±0.7	0.04
CRP (mg/L)	2.4±2.7	5.4±7.4	<0.0001	2.8±4.7	3.5±4.7	0.34
IL-6 (pg/ml)	1.1±1.1	2.8±13.7	0.14	1.1±0.8	2.9±16.9	0.27

Numerical values are means±SD. T-tests and χ^2 tests were performed to compare Whites and African Americans within gender groups. Abbreviations: GED, General Equivalency Diploma; BMI, body mass index; HDL-C, high density lipoprotein cholesterol; PA, physical activity; PSQI, Pittsburgh Sleep Quality Index; BDI-II, Beck Depression Inventory II; NBH, neighborhood; CRP, C-reactive protein; IL-6, interleukin-6.

Table 2. Multivariable Linear Regression of Social Cohesion and Natural Logged IL-6 by Race.

	White			African American		
	β	**SE**	**p**	**β**	**SE**	**p**
Model 1						
NBH Social Cohesion	0.005	0.040	0.910	-0.108	0.039	0.006
Adjusted for age, gender, and education						
Model 2						
NBH Social Cohesion	0.059	0.041	0.146	-0.096	0.038	0.012
Adjusted for Model 1 covariates + BMI, triglycerides, HDL-C, and statin use						
Model 3						
NBH Social Cohesion	0.051	0.043	0.245	-0.093	0.038	0.015
Adjusted for Model 2 covariates + smoking history, leisure time physical activity, and sleep quality (PSQI)						
Model 4						
NBH Social Cohesion	0.044	0.044	0.318	-0.097	0.038	0.013
Adjusted for Model 3 covariates + depressive symptoms (BDI-II)						

Abbreviations: IL-6, interleukin-6; NBH, neighborhood; BMI, body mass index; HDL-C, high density lipoprotein cholesterol; PSQI, Pittsburg Sleep Quality Index; BDI-II, Beck Depression Inventory II

Table 3. Multivariable Linear Regression of Social Cohesion and Natural Logged IL-6 by Race and Gender.

	White Women			African American Women			White Men			African American Men			Three-Way Interaction
	β	**SE**	**p**	**β**	**SE**	**p**	**β**	**SE**	**p**	**β**	**SE**	**p**	**p**
Model 1													
NBH Social Cohesion Adjusted for age and education	0.021	0.050	0.669	-0.148	0.045	0.001	-0.034	0.075	0.648	0.010	0.072	0.891	0.089
Model 2													
NBH Social Cohesion Adjusted for Model 1 covariates + BMI, triglycerides, HDL-C, and statin use	0.087	0.049	0.080	-0.133	0.044	0.003	0.010	0.080	0.900	0.022	0.076	0.778	0.064
Model 3													
NBH Social Cohesion Adjusted for Model 2 covariates + smoking history, leisure time physical activity, and sleep quality (PSQI)	0.079	0.053	0.141	-0.145	0.046	0.002	-0.002	0.086	0.983	0.079	0.070	0.266	0.039
Model 4													
NBH Social Cohesion Adjusted for Model 3 covariates + depressive symptoms (BDI-II)	0.054	0.055	0.329	-0.156	0.046	0.001	-0.001	0.087	0.987	0.076	0.071	0.287	0.031

Abbreviations: IL-6, interleukin-6; NBH, neighborhood; BMI, body mass index; HDL-C, high density lipoprotein cholesterol; PSQI, Pittsburg Sleep Quality Index; BDI-II, Beck Depression Inventory II