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Social Integration and Quality of Social Relationships as Protective Factors for Inflammation in a Nationally Representative Sample of Black Women

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Abstract Social integration and supportive relationships protect against cardiovascular disease (CVD). However, prior studies have examined heterogeneous samples which may obscure unique relationships within groups. We investigate the association between social relationships and inflammation—a known CVD risk factor—in Black women, a population with higher rates of CVD and CVD mortality. Secondary data from wave 4 of the National Longitudinal Study of Adolescent to Adult Health (Add Health) were analyzed. The sample was comprised of 1829 Black women aged 24–34 years. Social integration was a *z*-score standardized measure of four items (marital/cohabitation status, church attendance, volunteerism, close friendships). Data on the quality of three relationship types was available: perceived happiness with a romantic relationship and perceived closeness to mother and father figure. Inflammation was measured via high-sensitivity C-reactive protein (hs-CRP) in which levels were categorized based on clinical cut-points for risk of CVD (< 1 mg/L = low risk—reference, 1–3 mg/L = moderate risk, > 3–10 mg/L = high risk, > 10 mg/L = very high risk). Multivariable logistic regression was conducted accounting for the complex survey design and wave 4 control measures (e.g., body mass index, smoking, medications, acute illness, overall health, sociodemographic factors). No significant associations were found between level of social integration and hs-CRP levels. With respect to relationship quality, women who reported they were very happy with their romantic relationship were less likely than those who were only fairly happy or unhappy to have hs-CRP levels in the moderate- (AOR = 0.36, 95% CI = 0.17, 0.75), high (AOR = 0.20, 95% CI = 0.08, 0.49), or very high CVD–risk category (AOR = 0.36, 95% CI = 0.16, 0.80). Women who reported they were somewhat/quite/very close to their mother figure (AOR = 0.48, 95% CI = 0.25, 0.92) and those who reported having no mother figure (AOR = 0.25, 95% CI = 0.08, 0.77) were less likely than women reporting being not very close/not close at all with their mother figure to have hs-CRP levels in the moderate- vs. low-risk category. No statistically significant associations were found between father-figure relationship and hs-CRP CVD risk category. In summary, social integration and the quality of specific social relationships were significantly associated with inflammation in young adult Black women. Thus, interventions designed to enhance social connectedness and positive social relationships among Black women may have the potential to be protective for CVD risk. Further researches with the longitudinal social relationship and inflammatory measures are needed to better understand how changes in social relationships may influence CVD risk over the life course.

Keywords Social relationships · Cardiovascular disease · Inflammation · C-reactive protein · Social integration · Cardiovascular risk · Black women · African American women

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Background

Racial disparities in cardiovascular disease among women is prevalent in the USA, with non-Hispanic Black women having higher rates of CVD and CVD mortality in comparison to their non-Hispanic white peers as well as a greater number of CVD risk factors that often present earlier in the life course [1, 2]. C-reactive protein (CRP), a systemic inflammatory biomarker, is one intermediate CVD risk factor found across studies to be prospectively linked to CVD [3, 4] as well as to other CVD risk factors, such as type II diabetes [5, 6], hypertension [7, 8], and body mass index (BMI) [9]. As Black women have been found to have higher CRP levels in comparison to women from all other racial and ethnic backgrounds [10, 11], inflammation may play a role in explaining the racial disparity in CVD.

The evidence on the contribution of CVD risk behaviors to the development of CVD and CVD risk (including inflammation) is robust; thus, interventions have focused heavily on addressing behavioral lifestyle factors, such as implementing a healthier diet and increasing physical activity [12]. However, as evidence on the contribution of multiple aspects of social relationships to CVD and to CVD risk builds [13–18], incorporation of social processes into interventions has increased [19–21]. Social relationships are hypothesized to influence health through a variety of mechanisms, including role modeling, social influence, and social control of health behaviors, as well as through stress buffering or strain processes (e.g., social support, social isolation/social integration, relationship quality) [22].

Stress buffering and strain hypotheses are particularly salient to the role of inflammation in CVD risk [23]. Specifically, social isolation or psychological stress due to conflict or strain within a relationship can activate the physiological stress response system in which the hypothalamic-pituitary-adrenal (HPA) axis increases the production and release of cortisol and proinflammatory cytokines (e.g., interleukin(IL)-1, IL-6, and tumor necrosis factor-alpha [TNF-α]), which in turn stimulates the production of CRP. Although the activation of the stress response is adaptive for the management of an acute stressor, chronic or repeated activation can lead to a prolonged proinflammatory state and ultimately damage to the endothelium of the vascular system and the development of atherosclerotic plaques [23]. However, positive social relationships can buffer the negative effects of other life stressors, potentially preventing the chronic activation of the physiologic stress response or dampening the negative effect on health if the stress response is chronically activated.

To date, studies have examined numerous aspects of social relationships and their association with inflammatory biomarkers, including indices of social isolation/integration, social support, social strain/conflict, and relationship quality. Findings from most studies yielded significant associations in which conflict, strain, and isolation tend to be associated with higher levels of inflammation [14, 24–27] while positive social relationships, social support, and social integration have been linked to lower levels of inflammation [18, 28]. However, some studies have found null associations or mixed results based on the measure used (e.g., social support vs. social integration) as well as differences with the inclusion of behavioral controls [16, 29]. Uchino et al. recently conducted a large meta-analysis and found that social support (perceived and received) and social integration were significantly associated with lower levels of inflammation and that the effect did not vary by type of measure used, clinical versus non-clinical samples, or cross-sectional versus prospective studies [18]. Across studies, however, samples tend to be quite heterogeneous despite sex differences in several studies [30, 31]. Furthermore, in one study, perceived social support was significantly associated with lower CRP levels only in Black men and women [32]. Given the racial disparity in CVD risk (including inflammation), CVD, and CVD mortality for Black women compared to their non-Hispanic white peers [33], we focus our study on the associations between social relationships and inflammation among a nationally representative survey of non-Hispanic Black women in the USA. Specifically, we investigate social integration and perceived quality of three different relationship types—romantic partner, mother figure, and father figure.

Methods

Study Design and Sample

Secondary data from wave 4 of the National Longitudinal Study of Adolescent to Adult Health (Add Health) were analyzed for this study. Add Health is a longitudinal cohort study designed to examine the multiple contexts of health and well-being from adolescence through

adulthood [34]. Add Health researchers incorporated a multistage, stratified, and clustered sampling design to ensure a nationally representative sample of US schools with respect to the region of the country, urbanicity, school size, school type, and ethnicity. The first wave of data was collected in 1994–1995 when participants were in the 7th–12th grade. The participants were then re-interviewed in 1996 (wave 2), 2001–2002 (wave 3), and 2007–2008 (wave 4). The study team is currently in the field for wave 5. The overall unweighted response rate was 80.3%; analyses from Add Health found the bias from non-response was negligible and that participants in wave 4 were representative of those from wave 1 [35].

The sampling frame for this study included women who self-identified as non-Hispanic Black, participated in wave 4 of the Add Health data collection, and had complete data on the dependent variable (high-sensitivity C-reactive protein (hs-CRP) biomarker [$N = 1987$]). A total of 158 (8.6%) participants were missing data on the independent and control variables for a final sample of 1829. Analysis indicated that those missing data were more likely to be in the very high–risk category with hs-CRP > 10 mg/L than the low-risk category of < 1 mg/L and less likely to report having a very happy relationship with their romantic partner than those reporting a fairly happy to an unhappy relationship. Sensitivity analyses were conducted to examine the impact of missing data on the results of the multivariable logistic regression analyses; we compared the results using multiple imputation versus listwise deletion of missing data. The significance, direction, and magnitude of the results were consistent across both missing data strategies; thus, we present the results in which participants missing data were listwise deleted.

Measures

Dependent Variable

Inflammation: High-Sensitivity C-Reactive Protein Levels Add Health-trained field interviewers collected capillary whole blood samples via finger stick on the day of the wave 4 in-home interview. The blood was applied to filter paper, dried, and mailed with a desiccant to the Department of Laboratory Medicine at the University of Washington for assay analysis [36]. Sandwich ELISA methodology was utilized to measure the level of hs-CRP from the capillary dried blood spot consistent with prior research [36, 37]. The sensitivity of the CRP assay was 0.035 mg/L, the within-assay coefficient of variation was 8.1%, and the between-assay coefficient of variation was 11.0%. Comparison of hs-CRP values from the dried blood spot and plasma was conducted in a sample of 87 participants; linear correlations between the two measures were high with a Pearson $r = 0.98$ [36]. For the purpose of this analysis and our interest in hs-CRP as a clinical risk factor for CVD, we categorized the continuous hs-CRP levels into the following risk-based cut-points consistent with the Centers for Disease Control and Prevention (CDC) and the American Heart Association (AHA) recommendations [38] and prior research [28]: < 1 mg/L (low risk, reference), 1–3 mg/L (moderate risk), > 3–10 mg/L (high risk), and > 10 mg/L (very high risk, but also potentially indicative of an acute inflammatory process).

Independent Variables of Interest

Social Integration The measure of social integration is adapted from the Berkman-Syme Social Network Index (SNI) [39], which measures the number of social ties across four domains: marital status, friends or relatives, church attendance, and membership in social organizations. Prior research found the Berkman-Syme SNI to have predictive validity [39, 40] and the index has been adapted for use across numerous epidemiological cohort studies (e.g., National Health and Nutrition Examination Survey [31], Framingham Heart Study [29], and Nurses' Health Study [41]), including Add Health [28]. The social integration index was measured for this study with the following four items and cut-points consistent with prior research using the Add Health data [28] to facilitate comparisons of findings: currently married/cohabitating, attended church ≥ 12 times in the past 12 months, volunteered once or more in the past 12 months, and reported six or more close friends. One point was given if the participant was affirmative for the item, the items were summed, and the index was standardized.

Quality of Social Relationships Data were available in wave 4 of Add Health on the participants' perceived happiness in their current romantic relationship (regardless of relationship type) as well as their perceived closeness in their relationships with their mother figure and their father figure. As some participants reported not having a romantic partner or a mother or father figure, a

multinomial variable was constructed to include those participants who reported not having a relationship of this type. Specifically, for the level of happiness in participants' current romantic relationship, participants who reported no relationship and those who reported being very happy were compared to the referent category of participants who reported being only fairly happy or not at all happy with their current romantic relationship. Similarly, for perceived closeness to a mother figure and perceived closeness to a father figure, participants who reported having no relationship and those who reported having a somewhat, quite, or very close relationship were compared to the referent category of those participants who reported their relationship was not very close or not close at all. As a strained social relationship may be more detrimental to health than having no relationship, we selected the poor relationship quality as the referent category.

Control Measures

Measures potentially associated with inflammation were created and included in the analysis as control measures. As some of the measures (e.g., health behaviors, acute and chronic health conditions) could be mediators of the association between social relationships and inflammation, we also examined unadjusted models without the control measures. The control measures included: two measures of *socioeconomic status*: public assistance (on public assistance, welfare payments, or food stamps between waves 3 and 4) and college degree (bachelor degree or higher); *count of current subclinical symptoms* (e.g., fever, range 0–3); *count of current inflammatory/infectious diseases* (e.g., rheumatoid arthritis, range 0–3); *any anti-inflammatory medication use in prior 4 weeks* (e.g., nonsteroidal anti-inflammatory drug/salicylate, Cox-2 inhibitor, oral or inhaled glucocorticoid); *current pregnancy*; *hormonal contraceptive use in past year*; *age*; *foreign-born*; *current cigarette smoker*; and *self-reported general health* (ordinal measure ranging from poor to excellent).

Analytic Strategy

Descriptive analyses were first conducted to better understand the characteristics of the sample. An unadjusted and an adjusted multinomial logistic regression model was examined for the associations between social integration and inflammation and also for the associations between perceived quality of social relationships and inflammation. Sensitivity analyses were conducted in which each the relationship type (mother figure, father figure, and romantic partner) was examined in individual models and also combined in one model. The results were consistent with one another; thus, we present the results of the combined model. All analyses were conducted with SAS software, version 9.2 (SAS Institute, Cary, NC), accounting for the complex survey design.

Results

Descriptive Results

The characteristics of the sample are presented in Table 1. As depicted in the table, the hs-CRP levels were positively skewed in which 21.7% of the women were low risk with a hs-CRP level < 1 mg/L, 19.8% were moderate risk with a hs-CRP level 1–3 mg/L, 33.3% were high risk with a hs-CRP level > 3–10 mg/L, and 25.2% very high risk with a hs-CRP level > 10 mg/L. With respect to the social integration index, the mean prior to *z*-score standardization was 1.14 (range 0–4 with 4 being the most socially integrated) and the frequencies found approximately 28.6% of the women scored a 0 on the index, 37.4% scored a 1, 26.1% scored a 2, 7.1% scored a 3, and 0.80% scored a 4 (frequency results not depicted in the table). Based on the low proportion of women who scored a 4, we conducted a sensitivity analysis in which we collapsed categories 3 and 4 together. However, the logistic regression results were consistent whether measured as 0–4 range versus 0–3; thus, we present the results with the 0–4 range. Frequencies for each item that comprised the social integration index found that 41.9% of the women were married or cohabitating, 15.2% had 6 or more close friends, 27.9% volunteered at least once a year, and 29.0% attended church weekly or more. With respect to the perceived quality of social relationships, approximately 8.6% of the women reported being very happy with their romantic relationship partner, 69.9% reported being only fairly happy or unhappy with their romantic relationship partner, and 21.5% reported no romantic partner; 80.5% reported being somewhat, quite, or very close to their mother figure, 9.3% reported being not very close or not close at all with their mother, and 10.2% reported no mother figure; and 46% reported

being somewhat, quite, or very close to their father figure, 20% reported being not very close or not close at all with their father, and 34% reported no father figure. With respect to the sociodemographic characteristics of the sample, the mean age was 28.4 years (range 24–34 years), 1.9% were foreign-born, 9% had a college degree or more, and 52.2% reported receipt of public assistance in the year prior to the survey. With respect to the health-related measures, 4.6% of the women were pregnant; 34.1% reported hormonal contraceptive use in the year prior to the survey; 34.7% reported using anti-inflammatory medications in the month prior to the survey; 55.3% of the women had a BMI category of obese, 20.5% had a BMI category of overweight, and 24.2% had had a BMI category of under or normal weight; 11% of the women were cigarette smokers; the mean number of subclinical symptoms was 0.5 (range 0–3), the mean number of infectious or inflammatory conditions was 0.4 (range 0–3), and the mean self-reported overall health was 2.7 (range 1–5).

Multinomial Logistic Regression Results

The results of the multivariable logistic regression analyses are presented in Table 2. In the unadjusted model, no statistically significant associations were found between women's level of social integration and the hs-CRP categories (moderate-risk vs. referent low–risk AOR = 0.86, 95% CI = 0.70, 1.05; high-risk vs. referent low–risk AOR = 1.06, 95% CI = 0.83, 1.35; very high–risk vs. referent low–risk AOR = 1.05, 95% CI = 0.86, 1.27). Furthermore, no statistically significant associations were found between the level of social integration and the hs-CRP categories in the fully adjusted model accounting for the control variables (moderate-risk vs. referent low–risk AOR = 0.84, 95% CI = 0.68, 1.03; high-risk vs. referent low–risk AOR = 1.01, 95% CI = 0.78, 1.30; very high–risk vs. referent low–risk AOR = 1.00, 95% CI = 0.75, 1.33).

With respect to the women's perceived quality of social relationships, in the unadjusted model for romantic partners, women who reported they were very happy with their romantic relationship were less likely than those who were only fairly happy or unhappy to have hs-CRP levels in the moderate-risk (AOR = 0.34, 95% CI = 0.17, 0.72), high-risk (AOR = 0.20, 95% CI = 0.09, 0.45), or very high CVD–risk category (AOR = 0.35, 95% CI = 0.17, 0.71). No statistically significant associations were found between having no romantic partner

Table 1 Descriptive characteristics of 1829 non-Hispanic Black women in the analytic sample, wave 4 of the National Longitudinal Study of Adolescent to Adult Health, 2008

Outcome variable	% (*n*)
hs-CRP	
< 1 mg/L (low risk)	21.7 (418)
1–3 mg/L (moderate risk)	19.8 (397)
> 3–10 mg/L (high risk)	33.3 (563)
> 10 mg/L (very high risk)	25.2 (451)
Predictor variables of interest	
Social integration	Mean (SE)
Social integration index (range 0–4)	1.14 (0.05)
Social integration components	% (*n*)
Married or cohabitating	41.9 (732)
6 or more close friends	15.2 (301)
Volunteers at least once a year	27.9 (636)
Attends church weekly or more	29.0 (576)
Quality of social relationships	% (*n*)
Perceived happiness with romantic partner	
No partner	21.5 (423)
Fairly happy or unhappy	69.9 (1235)
Very happy	8.6 (171)
Perceived closeness to mother figure	
No mother figure	10.2 (169)
Not very close or not close at all	9.3 (177)
Somewhat, quite or very close	80.5 (1483)
Perceived closeness to father figure	
No father figure	34.0 (541)
Not very close or not close at all	20.0 (398)
Somewhat, quite, or very close	46.0 (890)
Control variables	% (*n*)
Foreign birth	1.9 (32)
College degree or more	9.0 (115)
Receipt of public assistance past year	52.2 (842)
Currently pregnant	4.6 (88)
Hormonal contraceptive use past year	34.1 (654)
Inflammatory medication use in the past month	34.7 (642)
BMI categories	
Obese	55.3 (960)
Overweight	20.5 (416)
Under/Normal weight	24.2 (453)
Current cigarette smoker	11.0 (199)
	Mean (SE)
Age in years (range 24–34)	28.4 (0.21)
No. of subclinical conditions (range 0–3)	0.5 (0.04)
No. of infectious/inflammatory conditions (range 0–3)	0.4 (0.04)
Self-reported overall health (range 1–5)	2.7 (0.06)

(versus being only fairly happy or unhappy with their romantic relationship) and any of the hs-CRP CVD risk categories. The findings of the unadjusted model were consistent with those in the fully adjusted model accounting for the control variables as women who reported they were very happy with their romantic relationship were less likely than those who were only fairly happy or unhappy to have hs-CRP levels in the moderate-risk (AOR = 0.36, 95% CI = 0.17, 0.75), high-risk (AOR = 0.20, 95% CI = 0.08, 0.49) or very high CVD–risk category (AOR = 0.36, 95% CI = 0.16, 0.80). In addition, no statistically significant associations were found between having no romantic partner (versus being only fairly happy or unhappy with their romantic relationship) and any of the hs-CRP CVD risk categories.

For quality of parent-child relationships, in the unadjusted model, women who reported having no mother figure were less likely than women who reported being not very close or not close at all with their mother figure to have hs-CRP levels in the moderate-risk category versus the low-risk category (AOR = 0.29, 95% CI = 0.09, 0.93). However, in the fully adjusted model accounting for the control variables, women who reported they were somewhat, quite, or very close to their mother

Table 2 Multivariable logistic regression results on the associations between social integration, social relationship quality, and inflammation among 1829 non-Hispanic Black women, wave 4 of the National Longitudinal Study of Adolescent to Adult Health, 2008

	hs-CRP		hs-CRP		hs-CRP	
	1–3 mg/L vs < 1 mg/L		> 3–10 mg/L vs < 1 mg/L		>10 mg/L vs < 1 mg/L	
Social integration index[1]	0.86	(0.70,1.05)	1.06	(0.83,1.35)	1.05	(0.86,1.27)
Social integration index[2]	0.84	(0.68, 1.03)	1.01	(0.78, 1.30)	1.00	(0.75, 1.33)
Happiness with romantic partner[1]						
Very happy	0.34	(0.17, 0.72)**	0.20	(0.09, 0.45)***	0.35	(0.17, 0.71)**
No partner	0.88	(0.54, 1.44)	0.67	(0.37, 1.22)	1.17	(0.75, 1.83)
Fairly happy-unhappy (reference)	–	–	–	–	–	–
Happiness with romantic partner[2]						
Very happy	0.36	(0.17, 0.75)**	0.20	(0.08, 0.49)***	0.36	(0.16, 0.80)*
No partner	1.15	(0.70, 1.90)	0.95	(0.48, 1.88)	1.77	(0.97, 3.22)
Fairly happy-unhappy (reference)	–	–	–	–	–	–
Closeness to mother figure[1]						
Somewhat, quite, very	0.54	(0.28, 1.03)	0.78	(0.38, 1.58)	1.29	(0.56, 2.97)
No mother figure	0.29	(0.09, 0.93)*	0.65	(0.26, 1.65)	1.001	(0.32, 3.10)
Not very, not close (reference)	–	–	–	–	–	–
Closeness to mother figure[2]						
Somewhat, quite, very	0.48	(0.25, 0.92)*	0.59	(0.28, 1.23)	0.93	(0.40, 2.20)
No mother figure	0.25	(0.08, 0.77)**	0.53	(0.21, 1.34)	0.83	(0.27, 2.55)
Not very, not close (reference)	–	–	–	–	–	–
Closeness to father figure[1]						
Somewhat, quite, very	1.35	(0.79, 2.30)	0.99	(0.43, 2.30)	1.91	(0.94, 3.87)
No father figure	1.24	(0.47, 3.25)	0.88	(0.40, 1.97)	1.06	(0.54, 2.07)
Not very-not close (reference)	–	–	–	–	–	–
Closeness to father figure[2]						
Somewhat, quite, very	1.35	(0.70, 2.61)	1.01	(0.47, 2.18)	1.92	(0.91, 4.02)
No father figure	1.06	(0.37, 2.99)	0.70	(0.28, 1.70)	0.93	(0.43, 1.99)
Not very-not close (reference)	–	–	–	–	–	–

[1] Unadjusted model

[2] Adjusted for control variables

* = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

figure (AOR = 0.48, 95% CI = 0.25, 0.92) as well as those who reported having no mother figure (AOR = 0.25, 95% CI = 0.08, 0.77) were less likely than women who reported being not very close or not close at all with their mother figure to have hs-CRP levels in the moderate-risk category versus the low-risk category. No statistically significant associations were found between perceived closeness to a father figure as well as no father figure and the hs-CRP CVD risk categories in the unadjusted or the fully adjusted models accounting for the control variables.

Discussion

Our study found support for the protective benefit to immune health of having close romantic relationships as well as close maternal relationships for young adult Black women in the USA. Specifically, the most robust finding was for women who reported being very happy in their relationship with their romantic partner, as they were less likely to have hs-CRP levels in the moderate-risk, high-risk, or very high CVD–risk range (vs. low CVD–risk range) in comparison to women who reported being only fairly happy or unhappy in their relationship. These findings are consistent with those from the extant literature on the protective benefits of romantic relationship satisfaction and the negative effects of romantic relationship conflict across health outcomes, including CVD and CVD risk factors, such as inflammation [25, 42–44]. Although most studies to date have focused on the quality of *marital* relationships, a closer examination on the effects of specific relationship types as well as other relationship characteristics and patterns may be insightful, as marriage rates are declining among all women in the USA, and they are lowest for Black women in comparison to the other racial and ethnic groups [45].

We also found that young adult Black women who reported feeling very close to a mother figure as well as those who reported having no mother figure were less likely to have hs-CRP levels in the moderate CVD–risk range versus the low CVD–risk range than women who reported being not very close or not close at all to their mother figure. These findings highlight the salience of the maternal-daughter relationship to immune health during young adulthood as well as the negative impact that a strained relationship may have on immune health in that having no mother figure may confer better health than having a strained relationship. Social strain and conflict within relationships have been found across the literature to have a negative impact on health, including increased inflammation and allostatic load [13, 17, 24, 25, 46, 47]. Although we did not find significant relationships between perceived closeness with a father figure and hs-CRP levels, young women's relationship with a mother figure may be particularly salient during young adulthood, as they are frequently navigating transitions in career, romantic relationships, and childrearing and may be reaching out to mothers in particular for social support.

Last, our study did not find statistically significant associations between the level of social integration and hs-CRP levels in this sample of young adult Black women. This finding is in contrast with prior research noting this association [18, 48], including the aforementioned study which examined the Add Health data retaining the full heterogeneous sample (men and women, diverse racial and ethnic groups) [28]. Potential reasons for the differences may be in the measurement of social integration, as the Black women in our study reported higher church attendance and fewer friends and were less likely to be currently married or cohabitating than the previous study. As the response options for hours of volunteering, number of friends, and church attendance in the Add Health data are categorical rather than continuous in nature, adjusting the cut-points based on the sample distribution is more difficult. Although not statistically significant, the parameter estimates in our study did trend in such a way to suggest that social integration may be protective; thus, future research may want to consider using continuous response options, as cultural differences in the definition of social integration may exist.

In addition to the aforementioned limitations with respect to the measurement of social integration, our study focuses only on the contemporaneous associations between social relationships and inflammation during young adulthood; thus, causal inferences cannot be established. Longitudinal analyses would be insightful, including investigations of the lagged associations between social relationships and immune health across the life course and as well as how changes in relationship structure, quality, and level of integration may influence variability in hs-CRP levels.

Despite these limitations, our study highlights the importance of social relationships to young adult Black women's immune health. Continued research and intervention development on how to build and maintain healthy social relationships and to manage conflict and strain with romantic partners and family members over

the life course is needed, including a better understanding of role changes within relationships (e.g., as an adult child becomes a caregiver to an aging parent). As the evidence is strong on the benefit of building social support to enhance the effectiveness of behavior change interventions, our findings reinforce the need to consider these approaches for promoting Black women's cardiovascular health.

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