Socioeconomic Status, Daily Affective and Social Experiences, and Inflammation During Adolescence

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ABSTRACT

Objective: To assess the relation between socioeconomic status (SES) and inflammation during adolescence and determine whether daily affective and social experiences across a 15-day period mediate this relation.

Methods: Adolescents ($n = 316$) completed daily diary reports of positive affect, negative affect, and negative social interactions for 15 days and provided whole blood spot samples for the assessment of C-reactive protein (CRP). Parents provided information on SES, including the highest level of education they and their spouses completed and household income.

Results: Lower parent education was associated with higher levels of adolescent CRP, controlling for age, sex, ethnicity, and body mass index ($\beta = -.12$, $p = .031$). Mean daily positive affect, negative affect, and negative social interactions were examined as potential mediators of this association. In these models, parent education was no longer associated with adolescent CRP ($\beta = -.09$, $p = .12$), and only positive affect was related to CRP ($\beta = -.12$, $p = .025$). Bootstrapping confirmed the mediating role of positive affect (indirect effect = -0.015, 95% confidence interval = -0.038 to -0.002).

Conclusions: Adolescents with less educated parents tended to have higher levels of CRP, which may be explained by their lower levels of positive affect. Findings suggest that a lack of positive affect may be a pathway by which SES confers early risk for poor health in adulthood. It is possible that adolescents who display positive affect during daily life in circumstances of relatively adverse socioeconomic circumstances may have better health outcomes related to lower inflammatory factors.

Key words: social status, CRP, positive affect, adolescents.

INTRODUCTION

The positive gradient between socioeconomic status (SES) and physical health has been well documented. Lower SES increases risk for premature death and numerous diseases, ranging from acute illness including upper respiratory infections and headaches, to chronic, life-threatening conditions, such as cardiovascular disease, diabetes, hypertension, obesity, and atherosclerosis (1–7). A growing number of studies have linked low SES to elevated levels of inflammation (8–10), a state implicated in several of the chronic diseases for which there are SES gradients (11–14). This suggests that increased inflammation may underlie, at least in part, some of the negative health effects of SES. Underlying mechanisms linking SES to inflammation remain unclear, and this area of research has primarily focused on adults despite the fact that the SES-inflammation link may emerge during adolescence (15–17) to confer early risk for poor health later in life.

Therefore, the purpose of the present study was to assess SES-inflammation associations and underlying socioemotional mechanisms in a sample of adolescents.

Negative social and affective experiences are hypothesized to mediate the link between SES and inflammation (18–20). Consistent with this notion, prior empirical studies of adults have shown that low-SES individuals tend to have more negative social experiences, including interpersonal loss, social conflict, poor-quality romantic relationships, disruptions in family relationships, exposure to harsh parenting, and hostile and unfriendly relationships (21–26). Low-SES individuals also have been shown to experience more depression, anxiety, and anger (27,28). Separate literatures have shown that these negative social and affective experiences are, in turn, associated with greater inflammation (29–35). Taken together, these literatures suggest that

BMI = body mass index, **CRP** = C-reactive protein, **SES** = socioeconomic status

negative social experiences and affect may explain the relation between SES and inflammation; however, only a handful of studies to date have empirically tested these pathways (36–38). To address this gap, the present study examined whether negative social experiences and negative affect underlie the link between SES and inflammation.

Most theoretical work and the few empirical studies have focused on negative experiences as mechanisms underlying the relation between SES and inflammation. However, the role of positive affect is important to examine given that positive and negative affect may represent separate dimensions of the affect system (39,40). As such, positive and negative affect can be activated in an opposing manner (e.g., increase in positive affect and decrease in negative affect), an uncoupled manner (e.g., increase in only positive affect), or in the same direction (e.g., increase in both positive and negative affect) (39,41). In turn, positive affect may affect inflammatory processes independent from negative affect.

Few studies have examined the relations among SES, positive affect, and inflammation. However, there is evidence that lower SES is related to lower positive affect (42), as well as lower happiness and subjective well-being (43–45). Research on positive affect and inflammation is relatively new, but several studies have found that greater positive affect, independent of negative affect, is associated with lower levels of circulating inflammatory markers (46,47) and stimulated production of proinflammatory cytokines (48). Given the links among SES, positive affect, and inflammation, the current study assessed whether positive affect accounts for the link between SES and inflammation.

Much of the work on SES, social and affective experiences, and inflammation has focused on adult samples. It may be particularly important to examine these links in adolescence given that the teenage years are marked by significant changes in social and affective processes. Specifically, salience of social interactions, particularly those with peers, concern with social status, and emergence of romantic relationships all occur during adolescence (49). In addition, negative affect tends to increase, whereas positive affect tends to decrease during adolescence, in part due to changes in neural networks underlying socioemotional processing and cognitive control (50–52). Because socioemotional development during adolescence lays the foundation for adult socioemotional functioning, and inflammatory processes are sensitive to social and affective factors, as described above, socioemotional experiences during adolescence can affect health in adulthood (53–56). Importantly, contextual factors, such as SES, can influence socioemotional experiences (42,57,58). Identifying underlying mechanisms linking SES and inflammation in adolescence, then, may help elucidate how SES contributes to early risk for chronic conditions in adulthood.

To better understand how SES affects health early in life and the mechanisms underlying this link, the current study examines whether daily social and affective experiences over a 15-day period mediate the link between SES and inflammation in a sample of adolescents. We focus on daily experiences because past studies have shown that SES affects daily experiences (42,57,58) and because daily experiences may accumulate over time to have a cumulative effect on inflammatory processes and health. For instance, negative social interactions and positive and negative affect averaged or aggregated across days have been shown to prospectively predict higher levels of inflammation, mortality, and chronic health conditions (29,30,59–61). Furthermore, in contrast to traditional questionnaire measures, daily diary methods do not ask respondents to generalize their experiences across time, and as such, they are less susceptible to recall biases (62).

The present study assessed whether parental reports of SES were related to adolescent inflammation and examined whether negative experiences and positive affect mediated the link. Parents of adolescents reported on educational attainment and income, and adolescents provided blood spot samples for C-reactive protein (CRP), a marker of inflammation, and completed daily reports of their social and emotional experiences for 15 days. On the basis of past research, we hypothesized that lower SES would be related to greater levels of CRP and with more negative social interactions and more negative and less positive affect. We further hypothesized that social experiences and affect would mediate the link between SES and CRP.

METHODS

Participants and Procedures

Participants were 316 adolescents (mean [standard deviation] age = 16.4 [0.74] years; 136 were male and 180 were female) recruited from the 10th and 11th grade classrooms of four high schools in the Los Angeles area. Adolescents were from European (29.1%), Latino (41.8%), Asian (23.1%), and other (6%) backgrounds.

Recruitment involved mailing fliers to students' homes and presenting the study and distributing study fliers to students in their classrooms. Study staff phoned interested families to provide more details about the study, and those who provided verbal parental consent were scheduled for an initial visit in participants' homes or a local field research center.

In the initial visit, study staff obtained written consent and primary caregivers reported on SES, whereas while adolescents completed a self-administered set of computer-assisted questionnaires. Whole blood spots were then collected for the assessment of CRP, after which participants were provided with instructions for the daily diary portion of the study.

After the initial visit, adolescents completed 4-page diary checklists of their social and emotional experiences each night for 15 consecutive days. The diary checklists took approximately 5 to 10 minutes to complete, and adolescents were instructed to complete diary checklists before going to bed each night. Diary checklists

completed after noon the following day were considered noncompliant. To help ensure compliance, participants were provided with 15 stickers to seal the diary checklists, an electronic time stamper, and a stamping booklet. The date and time were preprogrammed to the current date and time, and participants were instructed to stamp the stamping booklet to indicate when they completed the diary checklists. A security code on the time stamper prevented participants from altering the correct date and time. At the end of the 15-day period, study staff returned to participants' homes to collect completed materials. Adolescents received $50 for participating in the study. Participants who completed daily checklists correctly and on time also were mailed two movie passes. Approximately 94% of adolescents completed daily checklists for at least 14 days. Only 3.8% of adolescents completed the diary checklists for less than 7 days. Of the diaries that were completed, most (97.1%–99.3%) were completed before noon on the following day and were therefore judged to be compliant. More specifically, for any given day, only two to eight checklists were not completed on time. All study procedures were approved by the UCLA Institutional Review Board, and all data were collected between September 2011 and September 2012.

Measures

Socioeconomic Status

Parental education and household income were used as indicators of SES because these measures capture access to resources as well as prestige and are widely used in SES research (20). Primary caregivers, typically biological mothers (89.5%), reported their own and their spouse's highest level of education completed using an 11-point scale from (*1 = some elementary school, 11 = graduated from medical, law, or graduate school*). Highest levels of education were averaged across parents. Primary caregivers also reported specific dollar amount of total annual household income from all sources, including wages, salaries, government assistance, and dividends.

Daily Social Interactions

Each night for 15 consecutive nights, participants completed bedtime diary checklists that assessed whether they had encountered any of eight negative social interactions. Negative social interactions included argued with a parent, argued with another family member, argued with a friend, was punished by a parent, parents argued, something bad happened to a family member, had an argument or was punished by an adult at school, and was insulted, threatened, or made fun of by someone at school. These events were selected because they represent psychological stressors for adolescents across the domains of family, peers, and school (63,64) and have been associated with CRP (30). A summary variable for negative social interactions was created by summing across the different types of interactions for a given day, creating a variable to indicate whether a negative social interaction occurred that day, and lastly, averaging across days. Thus, the summary variable indicates percentage of days on which any one of the negative events occurred (30) and represents an index of individual difference in the experience of negative social interactions. Bivariate correlational analyses indicated good week-to-week stability ($r = 0.66$, $p < .001$).

Daily Affect

Each night for 15 consecutive nights, participants indicated the extent to which they felt 11 negative and 7 positive affect items using a 5-point scale (*1 = not at all, 5 = extremely*). Affect items were taken from the Profile of Mood States (65) and the Positive and Negative Affect Schedule (PANAS) (66). Negative emotions included sad, hopeless, discouraged, frightened, nervous, on edge, scared, threatened, uneasy, worried, and unsafe, and positive emotions included calm, interested, cheerful, enthusiastic, excited, happy, and joyful.

Negative affect items and positive affect items were averaged each day and then averaged across days to create composite negative affect and positive affect variables. To assess reliability of the measures, items were first averaged over time. α Coefficients were then computed across the mean item scores. The α coefficient of both negative affect (.94) and positive affect (.94) indicated that the measures possessed good internal consistency as measures of individual difference. There was also good week-to-stability in the experience of negative affect ($r = 0.75$, $p < .001$) and positive affect ($r = 0.84$, $p < .001$).

Adolescents also completed the joviality subscale of the PANAS (67), allowing for examination of whether daily assessment of positive affect and a more global measure of a dimension of positive affect are similarly related to parent education and CRP. During the initial visit, adolescents indicated the extent to which they felt happy, joyful, delighted, cheerful, excited, enthusiastic, lively, and energetic in the past week, using a 5-point scale (*1 = very slightly or not at all, 5 = extremely*).

C-reactive Protein

Dried blood spots (DBS), a well-validated, relatively noninvasive procedure, was used for the assessment of CRP (68). This method for CRP assessment is increasingly used in community and population-based studies, and validation studies indicate a high correlation between CRP from DBS and CRP from plasma and serum (r values ≥ 0.96) (68–70). Blood spots were collected at baseline during the initial visit before assessment of daily experience. Trained study staff (medical personnel are not required for this procedure) first cleaned each participant's finger with alcohol. Using a sterile, disposable microlancet commonly used by diabetic patients, study staff next punctured the participant's finger. Five drops of capillary blood was then allowed to fall onto standardized filter paper. Blood spot samples were covered and allowed to dry overnight (cytokines are stable in DBS at room temperature for up to 14 days (68)), after which they were stored at −80°C until shipped to the Laboratory for Human Biology Research at Northwestern University. Levels of CRP were assessed using high-sensitivity enzyme-linked immunosorbent assay, which has a lower detection limit of 0.030 mg/l. Seven samples fell under the lower detection of limit. All samples were run in duplicate, and intra-assay and inter-assay coefficients of variation were less than 6.4% and less than 9.3%, respectively.

Covariates

During the initial visit, trained staff assessed height and weight for body mass index (BMI) and adolescents reported on their age, sex, and ethnicity. Adolescents also reported on certain health

behaviors, including smoking and alcohol consumption and sleep duration.

Cigarette use and alcohol consumption were assessed using items from the Youth Risk Behavior Survey (71). More specifically, adolescents reported the number of cigarettes smoked per day in the last 30 days and the number of days they had at least one alcoholic beverage in the last 30 days. Adolescents were assured that their responses to such questions would remain confidential and not be shared with anyone.

Sleep duration was assessed using daily checklists during the first 7 days of the daily diary period. Each morning participants reported the time they turned off the lights to sleep, the number of minutes it took them to fall asleep, and the time they woke in the morning. Sleep duration for each night was based on the time between turning off the lights and waking in the morning minus the time it took to fall asleep. Average sleep duration was then computed by averaging sleep duration each night across the 7-day period.

Statistical Analysis

CRP levels were first examined for values greater than 10 mg/l, given that such levels are indicative of an acute inflammatory response likely due to infection (72). Four participants had CRP levels greater than 10 mg/l. Self-reports of illness confirmed that these participants had an acute infection in the last 24 hours. Thus, these four participants were excluded from analyses including CRP as a variable of interest. CRP values were skewed and thus log transformed to correct for nonnormality.

To examine whether SES was associated with higher levels of inflammation, regression analyses predicting CRP from SES variables (i.e., parent education and income) were conducted. Any significant associations between the SES variables and CRP were then tested for mediation by psychosocial experience variables (i.e., positive affect, negative affect, and negative social interactions) by adding psychosocial experience variables to models predicting CRP from SES. Given that indirect effects are not normally distributed, significance testing of any indirect effects was conducted using 95% bias-corrected bootstrap

confidence intervals (CIs) based on 5000 bootstrap samples (73). Indirect SPSS macros (Preacher & Hayes, 2008) was used to conduct the bootstrapping analyses.

Except for the four participants whose CRP levels were greater than 10 mg/l, all available data, including those not completed on time, were included in analyses given the high rates of compliance. All analyses included age, sex, ethnicity, and BMI as covariates because these variables have previously been related to inflammation (74).

RESULTS

Sample demographic, psychosocial, and biological characteristics are presented in Table 1. Participants were from middle-class backgrounds. On average, parents completed some vocational or trade school. Approximately 29% of participants had parents who completed high school or less, 42.4% had parents who completed some college, 16.8% had parents who completed college, and 11% had parents who at least completed some medical, law, or graduate school. The median household income was $50,000.

Negative social interactions were relatively uncommon, occurring on about 4.35 of the 15 days (29% of days). Arguing with a parent was the most common negative interaction, with 65.5% of adolescents reporting that it occurred at least once over the 15-day period. The next most common negative interaction was arguing with other family member (42.5%), followed by arguing with a friend (35.5%) and something bad happening to a family member (26.8%). The least common stressors were arguing with or punished by an adult at school and threatened or insulted by someone at school, with 11.5% of adolescents reporting their occurrences.

As shown in Table 1, average levels of CRP were somewhat low. According to clinical cutoff points used to assess risk for cardiovascular disease (75), 255 adolescents were in the low-risk category (CRP < 1 mg/l), 37 adolescents were

TABLE 1. Participant Characteristics ($n = 302$–313)

Variable	Mean	SD	Range
Parent education	7.19	1.81	1.5–11
Household income	$70,316.71	$76,665.98	0–825,000
Positive affect	2.88	0.71	1.12–5
Negative affect	1.34	0.40	1–3.73
Negative interactions	0.29	0.25	0–1
BMI, kg/m^2	23.16	5.01	14.68–47.58
Age, y	16.40	0.74	14.5–20.5
CRP, mg/l	0.96	2.92	0.001–36.37
CRP, mg/l (excluding >10 mg/l)	0.69	1.27	0.001–8.45

SD = standard deviation; BMI = body mass index; CRP = C-reactive protein.
Categories for parent education were 1 = some elementary school; 2 = completed elementary school; 3 = some junior high school; 4 = completed junior high school; 5 = some high school; 6 = graduated high school; 7 = trade or vocational school; 8 = some college; 9 = graduated from college; 10 = some medical, law, or graduate school; and 11 = graduated from medical, law, or graduate school.

TABLE 2. Bivariate Correlations Between SES, Daily Experience, and CRP (n = 287–306)

	1	2	3	4	5	6	7	8
1. Parent education								
2. Household income	0.34**							
3. Negative interactions	0.12*	−0.04						
4. Negative affect	0.06	0.01	0.45**					
5. Positive affect	0.16**	0.08	−0.04	0.00				
6. Age	−0.16**	−0.05	0.01	0.01	0.012			
7. BMI	−0.12*	−0.17**	0.05	−0.03	−0.07	0.08		
8. lnCRP	−0.18**	−0.04	0.00	−0.10	−0.18**	0.24**	0.47**	

SES = socioeconomic status; CRP = C-reactive protein; BMI = body mass index.

* $p < .05$, ** $p < .01$, *** $p < .001$.

in the moderate-risk category (CRP = 1–3 mg/l), and only 18 adolescents were in the high-risk category (CRP > 3 mg/l).

Bivariate correlations among the study variables are shown in Table 2. Higher parent education was associated with higher household income. Higher parent education, but not household income, was associated with greater frequency of negative social interactions and higher levels of positive affect. Similarly, only higher parent education was associated with lower levels of CRP. Among the psychosocial experience variables, only higher levels of positive affect were related to lower levels of CRP.

Hierarchical regression analyses first focused on the relation between the SES indicators and CRP, controlling for age, sex, ethnicity, and BMI (see Table 3, column 1). Higher levels of parent education were associated with

lower levels of CRP ($p = .031$). Household income was not related to levels of CRP (b [standard error {SE}] = 0.00 [0.00], $\beta = .04$, $p = .47$). Given the shared variance among positive affect, negative affect, and negative social interactions, we then added these potential mediating variables to the model (Table 3, column 2). The association between parent education and CRP was attenuated ($p = .12$), and only the association between positive affect and CRP was significant ($p = .025$).

Given that the regression results suggested that positive affect mediated the relation between parent education and CRP, additional analyses were conducted to estimate this mediation. As shown in Figure 1, parental education predicted higher positive affect after controlling for age, sex, ethnicity, BMI, negative social interactions, and negative
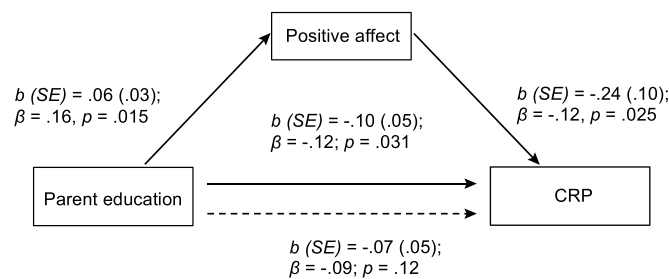
TABLE 3. Regression Analyses Predicting CRP From Parent Education and Daily Experience Variables

	1 (n = 298)		2 (n = 287)	
	b (SE)	β	b (SE)	β
Intercept	−9.48 (1.78)***		−7.93 (1.75)***	
Age	0.37 (0.10)***	.19	0.35 (0.10)***	.18
Female	0.15 (0.15)	.05	0.16 (0.15)	.06
Latino	−0.12 (0.19)	−.04	−0.10 (0.18)	.00
Asian	−0.40 (0.22)	−.11	−0.43 (0.21)	−.13
Other	0.01 (0.33)	.00	0.05 (0.33)	.01
BMI	0.12 (0.02)***	.43	0.11 (0.02)***	.41
Parent education	−0.10 (0.05)*	−.12	−0.07 (0.05)	−.09
Positive affect			−0.24 (0.10)*	−.12
Negative affect			−0.39 (0.20)	−.11
Negative social interactions			−0.01 (0.33)	.00

CRP = C-reactive protein; SES = socioeconomic status; BMI = body mass index.

Sex was dummy coded. European Americans were coded as the reference group for ethnicity.

* $p < .05$, ** $p < .01$, *** $p < .001$.

FIGURE 1. Mediation of the relation between parent education and CRP by positive affect. Regression analyses predicting positive affect from parent education controlled for age, gender, ethnicity, BMI, negative social interactions and negative affect. Regression analyses predicting CRP from positive affect controlled for age, gender, ethnicity, BMI, parent education, negative affect, and negative social interactions. Unadjusted relation between parent education and CRP (solid line) controlled for age, gender, ethnicity, and BMI. Adjusted relation between parent education and CRP (dashed line) controlled for age, gender, ethnicity, BMI, positive affect, negative affect, and negative social interactions. CRP = C-reactive protein; SE = standard error.

affect. Positive affect, in turn, predicted CRP with the same controls and parent education. Mediation of the initial parental education–CRP association by positive affect was confirmed by bootstrapping (indirect effect [SE] = −0.015 [0.01], 95% CI = −0.038 to −0.002). Given that smoking, alcohol consumption, and sleep duration have been shown to affect inflammatory processes (74), we also conducted analyses with these additional health behavior covariates. Controlling for health behaviors did not alter results.

We also examined single mediation models in which each psychosocial variable was added separately rather than simultaneously to the model predicting CRP from parent education because of potential suppressor effects of one psychosocial variable on another in a multiple mediation model. The single-mediation models yielded similar results: only positive affect mediated the association between parent education and CRP.

Although we collapsed education across the two parents to obtain a measure of family SES, family SES may also be represented by the higher status of two parents. We conducted analyses in which parent education was coded as the greater amount of education completed of the two parents, which yielded similar results.

Because inflammation may induce sickness behaviors, including increases in negative affect and decreases in positive affect (76,77), lower levels of CRP may account for the association between higher parent education and higher positive affect (rather than vice versa). As such, we examined a meditational model with CRP as the mediator and positive affect as the outcome. In this model, higher parent education was significantly related to higher levels positive affect (b [SE] = 0.06 [0.03], β = .16, p = .015) and marginally related to lower levels of CRP (b [SE] = −0.09 [0.05], β = −.11, p = .057), controlling for age, sex, ethnicity, BMI, negative affect, and negative social interactions. When CRP was added to the model predicting positive affect from parent education, the association between parent education and positive affect was attenuated (b [SE] = 0.06 [0.03], β = .14, p = .029), whereas the association between CRP and positive affect

was significant (b [SE] = −0.08 [0.03], β = −.15, p = .025). Bootstrapping confirmed partial mediation of the parent education–positive affect relation by CRP (indirect effect [SE] = 0.007 [0.01], 95% CI = 0.001–0.019).

In light of increasing evidence indicating that compared with conventional global self-reports, psychosocial experiences assessed near real-time experience may be more strongly related to markers of biological processes (78), we examined whether the joviality subscale of the PANAS also mediated the parent education–CRP association. The PANAS measure and daily measure of positive affect were significantly correlated (r = 0.50, p < .01). However, unlike positive affect assessed using daily checklists, the PANAS measure of positive affect was not correlated with parent education (r = −0.01, p = .85) and CRP (r = −0.07, p = .25) and did not mediate the association between parent education and CRP levels (indirect effect [SE] = 0.001 [0.005], 95% CI = −0.007 to 0.015).

DISCUSSION

The current study examined the relationship between SES and inflammation and the mediating role of social interactions and affect in an ethnically diverse sample of adolescents. Consistent with our hypothesis, lower parent education was associated with higher levels of CRP. Negative social and affective experiences did not account for the relation between parent education and inflammation. However, we found evidence that the association between parent education and inflammation was mediated by daily positive affect, even among adolescents whose CRP levels are fairly low. This finding is consistent with the only other study that we are aware of examining SES and daily positive affect (42) and with past studies showing an inverse relationship between positive affect and inflammation (46,47).

Curiously, only parent education, but not household income, was related to CRP. A possible explanation is that education is typically completed by early adulthood, and therefore, parent education tends to remain relatively constant for most children and youth. By contrast, income

tends to vary much more across time (79). As such, a single assessment of income may reflect current SES, whereas a single of assessment of education may better capture SES across time. To the extent that experiences over time accumulate to affect inflammatory processes (80) and that that early childhood may be a sensitive period during which social context can program inflammatory processes (81), parent education, then, may be a better predictor of inflammation during adolescence. Consistent with this notion, a recent study that included income and education in a combined model found that only education was inversely related to interleukin-6, whereas income was not related to markers of inflammation (17).

To our knowledge, the present study is one of the first to examine positive affect as a pathway by which SES affects inflammatory processes in adolescents. Results indicate that adolescents with less educated parents tended to experience lower levels of positive affect independent of negative social interactions and negative affect. This suggests that the lower levels of positive affect among these adolescents do not reflect a presence of more negative experiences. Similarly, the finding that adolescents with lower levels of positive affect tended to have higher levels of CRP independent of parent education, negative affect, and negative social interactions suggests that, to the extent that adolescents can maintain positive affect in the face of socioeconomic disadvantage and daily negative experiences, they may be able to maintain lower levels of inflammation.

That we found evidence for associations between positive affect, but not negative experiences, and inflammation, is consistent with past studies demonstrating that positive affect is related to inflammatory processes independent of negative affect. Together, these studies suggest that a lack of positive affect, and not just the presence of negative experiences, can have harmful effects on inflammatory processes and health. The present finding extends the growing literature on the effects of positive affect on inflammatory processes by revealing that the link between positive affect and inflammation is evident relatively early in life and that contextual factors such as SES may decrease positive affect. More studies are needed to identify individual characteristics and other contextual factors that may increase vulnerability to a lack of positive affect.

Interestingly, in contrast to the daily measure of positive affect, the PANAS measure of joviality, a global assessment of a dimension of positive affect, was related neither to parent education nor to CRP. This discrepancy is consistent with growing literature showing that biological markers may be more sensitive to more proximal assessments of psychosocial experiences than to global self-reports (78). The PANAS measure of positive affect required participants to generalize their feelings of positive emotions over the past week, which may result in responses reflecting semantic knowledge and memory (78). By contrast, daily assessment of positive affect was closer to real-time experience and thus may more accurately reflect actual experience (78). As such, positive affect assessed using daily checklists, but not by a global measure, may have mediated the association between parent education and CRP levels.

We also found no relation between SES and mean daily negative affect, which contrasts a body of work showing an inverse association between SES and negative affect such as depression, anxiety, and anger (27). Of note, these studies have primarily used conventional, global self-reports of negative affect. The lack of association between SES and mean daily negative affect found in the present study is consistent with prior daily diary studies that have also found nonsignificant associations between SES and daily measures of negative affect (26,42). Together, these findings suggest that SES may be related to negative emotions assessed by conventional self-reports rather than to those assessed by more proximal measurers of actual experience.

Negative social interactions did not mediate the relationships between SES and inflammation. Contrary to our hypothesis, parent education was related to higher levels of negative social interactions. Although it is widely believed that SES is inversely related to stressful experiences, including negative social interactions, findings have been mixed, with studies showing no relationship between SES and stressful experiences and other studies showing a positive association (82). The discrepancy among findings may stem from the fact that stress is multifaceted and consequently has been operationalized in various ways (82). Indeed, in a recent study, higher SES was related to greater chronic stress, but lower perceived stress and low-control daily stress, and was unrelated to daily demands (83). More studies are needed to identify which aspects of stress are related to higher SES and why.

The lack of association between the frequency of daily negative social experiences and CRP contrasts previous work demonstrating a positive association between frequency of daily interpersonal stress and inflammation among adolescents (84). Although the frequencies of negative social interactions were consistent across the two studies (mean = 0.29 versus mean = 0.33), age and CRP levels differed between the two studies, which may contribute to the discrepant results.

Specifically, inflammation is known to increase with age, and given that the current sample was younger (16.4 versus 18.4 years) than the sample in the study by Fuligni and colleagues (84), they had lower levels of CRP (.69 mg/l versus 1.26 mg/l). The effects of negative social experiences on inflammation at younger ages when inflammation is relatively low may be better observed when the system is challenged (85,86). They may also depend on other factors such as coping (87) or genetic variation (88).

Limitations of the current study warrant caution in interpreting results. First, the nonexperimental design of the

study precludes inferences of causality. Previous work indicates that higher levels of inflammation can lead to decreases in positive affect (76), and indeed, additional analyses showed that higher levels of CRP may help explain the association between lower parent education and lower positive affect. Experimental studies manipulating subjective social status or positive affect and prospective, longitudinal studies examining the effects of upward or downward mobility in SES on positive experiences and inflammation could help elucidate causal links among SES, positive affect, and inflammation. Given the correlational nature of the study, a third variable may also be implicated. Analyses controlling for demographic characteristics, BMI, smoking, alcohol consumption, and sleep duration suggest that these factors do not account for the associations among parent education, positive affect, and CRP. However, the present study did not assess other variables that have been associated with SES, positive affect, and inflammation. For instance, higher SES is associated with more physical activity in adults and adolescents (89), and physical activity, in turn, is related to greater positive affect (90) and lower levels of CRP (91). Assessment or manipulation of physical activity and other variables related to SES, positive affect, and inflammation in future studies could help clarify underlying pathways linking SES, positive affect, and inflammation. Second, daily experience was assessed after blood spot collection for assessment of CRP. However, levels of CRP are relatively stable across an 18-month period ($\rho = 0.67$) (92). Furthermore, daily assessment techniques are based on sampling experience, and thus, daily diaries provide glimpses into people's typical experiences. Indeed, there was good week-to-week stability in the occurrence of social and affective experiences in the present sample (all r values ≥ 0.66). Lastly, the health implications of the present findings are unclear because we did not examine health outcomes.

The low levels of CRP in our sample indicate that adolescents facing socioeconomic disadvantage are not currently at risk for poor health. Nevertheless, to the extent that these adolescents facing socioeconomic disadvantage continue to experience low levels of positive affect over extended periods, they may become at increased risk for particular chronic conditions later in life. This is an important direction for future research.

Despite these limitations, the present study nevertheless extends previous work on the mechanisms underlying the SES-health gradient. It is one of the few studies to empirically test potential psychosocial pathways linking SES to inflammation and is one the first to do so in a sample of adolescents. Past studies have shown that adiposity, chronic stress, and threat perception do not completely explain the association between SES and inflammation (17,37).

Results from the present study suggest that a lack of positive affect is another pathway by which SES affects inflammatory processes. A lack of positive affect, then, may be an additional mechanism that confers early risk of low SES for poor adult health.

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