Neighborhood, Family, and Subjective Socioeconomic Status: How Do They Relate to Adolescent Health?

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This study investigated the role of neighborhood, family, and individual subjective socioeconomic status (SES) in predicting adolescent physical health and psychological characteristics. Three hundred fifteen adolescents completed assessments of blood pressure, cortisol, and body mass index (BMI). Results revealed that lower neighborhood SES was associated with higher BMI and lower basal cortisol levels and that these effects persisted after controlling for family SES. Both family SES and neighborhood SES predicted negative psychological characteristics and experiences such as hostility and discrimination. In contrast, only subjective SES predicted positive psychological characteristics. These findings suggest the importance of understanding influences at the individual, family, and neighborhood levels for optimally targeting interventions to reduce health disparities earlier in life.

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Socioeconomic status (SES) has a profound effect on physical health outcomes. Numerous studies have documented that lower SES is associated with poorer health (see Adler et al., 1994; N. B. Anderson & Armstead, 1995; Marmot, Kogevinas, & Elston, 1987; Williams & Collins, 1995, for reviews). Lower SES is linked to multiple types of health outcomes, including higher rates of disease-specific morbidity and mortality (Adler et al., 1994; Marmot et al., 1987), poorer physiological indicators of health (Kubzansky, Berkman, Glass, & Seeman, 1998; Seeman & McEwen, 1996), and less adaptive psychological characteristics (Cohen, Kaplan, & Salonen, 1999; Taylor & Repetti, 1997) in adulthood. During childhood, similar relationships emerge (Chen, 2004; Chen, Matthews, & Boyce, 2002; Starfield, Riley, Witt, & Robertson, 2002a; Starfield, Robertson, & Riley, 2002b), although less data are available.

Previous researchers have reported associations of various SES measures with health outcomes (Adler & Ostrove, 1999; Williams et al., 1995). However, more recently, researchers have begun advocating the need for distinguishing different types of SES indicators as a method for better understanding the pathways between low SES and health. SES is a multidimensional construct; thus, the measures one chooses can reflect different underlying conceptualizations about how SES operates (Winkleby, Jatulis, Frank, & Fortmann, 1992).

For example, SES can be measured at multiple levels (Krieger, Williams, & Moss, 1997). The characteristics of an individual, the characteristics of one's family, or the characteristics of the neighborhood in which one lives could each define the SES of an individual, yet each represents a unique aspect of SES. Neighborhood SES measures are an aggregate measure of the group of individuals living in a neighborhood and include indicators such as the percentage of adults with less than a high school education in the neighborhood and median family income of the neighborhood. These characteristics describe the larger community context in which an individual lives and could affect health through several pathways. For example, neighborhood stressors such as exposure to violence are linked to SES (Sampson, Raudenbush, & Earls, 1997) and may, in turn, affect physical health (Wright et al., 2004; Wright, Hanrahan, Tager, & Speizer, 1997; Wright, Speizer, Tager, & Hanrahan, 1998). A second pathway may be through the social networks in a neighborhood. Social capital, which is defined as the level of trust and norms of cooperation and behavior, may relate to both SES and health (Jencks & Mayer, 1990; Kawachi, Kennedy, & Glass, 1999; Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997). Other pathways may include the material resources of the neighborhood (e.g., availability of health care clinics and quality of grocery stores; Evans, 2004; MacIntyre, Maciver, & Sooman, 1993) and the physical conditions of the neighborhood (e.g., pollution levels; Buzzelli, Jerrett, Burnett, & Finklestein, 2003; Evans, 2004).

At the family level, SES describes a narrower social context—the family itself—in which an individual exists and includes measures such as family income and family savings. Family SES may also affect health through a variety of pathways. First, family stressors such as conflicts and unresponsive parenting styles have been linked to both SES and health (Repetti, Taylor, & Seeman, 2002; Taylor et al., 1997). Second, family relationship quality may provide a source of support, which is known to buffer individuals from the physiological effects of stress (Cohen & Wills, 1985). Family members may also serve as role models influencing the

health behaviors of those around them through their own behaviors (Lau, Quadrel, & Hartman, 1990). Finally, the material assets of a family may indicate the resources that families have to deal with health or life stressors, which in turn may affect the individual's health.

At the individual level, SES can be measured objectively or subjectively. Among adults, individual objective measures center around the education, occupation, or income of a single individual, rather than the family or neighborhood. The subjective approach is based on the notion that most individuals do not understand SES in terms of absolute dollars but in terms of where they stand relative to their peers and that an individual's perception of their social standing may be more important to health outcomes than objective measures (Adler, Epel, Castellazzo, & Ickovics, 2000). In adult studies, subjective perception of SES has been associated with both physical and psychological health outcomes (Adler et al., 2000; Ostrove, Adler, Kuppermann, & Washington, 2000).

Understanding which specific level of SES indicator is associated with health is critical for effective interventions to reduce health disparities. For example, if neighborhood-level variables have the strongest association with health, this suggests that interventions should aim to change the characteristics of neighborhoods to maximally improve individual health. In contrast, if family-level variables have the strongest association with health, this suggests that intervention should specifically target high-risk families rather than all families within a neighborhood.

A few previous studies have addressed the question of whether certain levels of SES have stronger effects on physical health than others. These studies have been conducted in adult populations. Neighborhood SES remained a significant predictor of a variety of self-reported health variables after controlling for individual (objective) and family SES in community samples of adults (Gould & Jones, 1996; Malmstrom, Johansson, & Sundquist, 2001; Robert, 1998). Neighborhood SES also has predicted objective health data, such as respiratory functioning, after individual objective SES was controlled in a community sample of adults (Jones & Duncan, 1995). Finally, neighborhood SES predicted disease morbidity and mortality outcomes after individual and family SES were controlled (R. T. Anderson, Sorlie, Backlund, Johnson, & Kaplan, 1997; Diez-Roux et al., 2001; Haan, Kaplan, & Camacho, 1987).

However, it should be noted that, although neighborhood effects often remain significant after controlling for individual or family effects, several studies have found that individual or family SES has a stronger magnitude of association than neighborhood SES when both are included as predictors (R. T. Anderson et al., 1997; Malmstrom et al., 2001; Robert, 1998). In addition, one study found no effect of neighborhood SES on mortality after individual SES was taken into account (Sloggett & Joshi, 1994). Finally, there is some evidence that subjective SES remains a significant predictor of physical and psychological health after individual objective and family SES have been controlled (Adler et al., 2000; Goodman et al., 2001).

To date, we are not aware of any studies that have investigated the relative influence of neighborhood, family, and subjective SES variables on physical health outcomes during childhood, and yet researchers often emphasize the importance of intervening earlier in life to maximize effects on health disparities. The goal of the present study then was to test the role of different levels and types of SES variables on adolescent physical health and psychological characteristics.

The role of neighborhoods has received attention in the child development literature for outcomes such as academic and social competence (Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993; Leventhal & Brooks-Gunn, 2000; McLoyd, 1998). However, this discussion has been largely absent from the child health literature. Previous reviews have documented that low SES is associated with poor physical health outcomes in childhood (Chen et al., 2002; Starfield et al., 2002a, 2002b). These studies have focused on childhood health problems such as obesity, health behaviors such as substance use, and physiological indicators of health such as blood pressure or cortisol (Goodman, 1999; Goodman et al., 2001; Goodman & Huang, 2002; Lupien, King, Meaney, & McEwen, 2000; West, 1988; West, MacIntyre, Annandale, & Hunt, 1990; Winkleby, Robinson, Sundquist, & Kraemer, 1999). However, the approach of testing the relative roles of neighborhood, family, and individual subjective SES as a means of understanding pathways to health has not been addressed in the child health literature; thus it forms the focus of the present study.

In the present study, we tested associations between different types of SES measures and adolescent physical health measures, as well as psychological characteristics. We hypothesized that SES measures at the neighborhood, family, and subjective level would be associated with adolescent physical and psychological variables, so that lower SES would be associated with poorer biological profiles (higher body mass index [BMI], blood pressure, and heart rate, dysregulated cortisol), higher levels of negative psychological characteristics and experiences (threat perception, hostility, discrimination), and lower levels of positive psychological characteristics (optimism, self-esteem, perceived control). Second, we addressed the question of whether one type of SES variable most strongly predicts physical health and psychological characteristics and experiences by analyzing the contributions of the different levels of SES variables simultaneously.

Method

Participants

The participants for this article came from three different study samples. All three samples were collected from local public high schools in the St. Louis, MO, area with a wide range of SES and ethnic diversity. Each sample had some overlapping physiological and psychological data collection procedures. The three samples were pooled for the present article. School flyers, announcements, and classroom presentations were used to inform students about the study, and those interested in participating contacted our lab. Exclusion criteria for study participation included chronic illness or medication use that affected the cardiovascular system. Approximately 12% of families who called were ineligible.

Sample 1 consisted of 100 students whose ages ranged from 15 to 19 years ($M = 17.3$). Sixty-four percent were female; 53% were Caucasian, and 47% were African American. Sample 2 consisted of 115 participants whose ages ranged from 16 to 19 years ($M = 16.8$). Sixty-one percent were female; 42% were Caucasian, 57% were African American, and 1% was Native American. Sample 3 consisted of 100 students whose ages ranged from 14 to 18 years ($M = 15.6$). Fifty-three percent were female; 75% were Caucasian, 21% were African American, and 4% were Asian. The SES characteristics of our sample were similar to the characteristics of the school district from which the sample was drawn. In the school district, the median family income was in the $50,000–$74,999 range, 50% of adults

had a college degree or higher, and 80% of families owned homes (based on 2000 U.S. Census data). In our sample, the average family income was in the $50,000–$74,999 range, 61% of parents had a college degree or higher, and 87% of families owned homes.

Measures

SES can be conceptualized as an indicator of prestige within society or as an indicator of resources. Prestige-based indicators include educational attainment and occupational status (Krieger et al., 1997; Winkleby et al., 1992). Resource measures include family income and savings (Krieger et al., 1997; Winkleby et al., 1992).

At the neighborhood level, we obtained 2000 U.S. Census data at the block-group level based on street addresses from each family. Census block groups represent subdivisions of census tracts that are relatively homogenous in social and economic characteristics (Krieger et al., 1997). Census block groups are more precise than zip codes. For example, the 315 participants in our study came from 123 different block groups. As an indicator of neighborhood education, we obtained the percentage of families in the neighborhood with less than a high school education. As an indicator of occupation, we obtained the percentage of families that were unemployed in the neighborhood. As an indicator of income, we obtained the median family income for the neighborhood. As an indicator of assets, we obtained the median value of owner-occupied houses in the neighborhood.

At the family level, we interviewed parents about family SES indicators. As an indicator of education, we assessed the parents' number of years of education. As an indicator of occupation, we asked parents to provide us with their occupational title and coded them using Hollingshead's Four-Factor Index of Social Status (Hollingshead, 1975). An average score was created from two-parent families, and a single score from one-parent families was used. Average scores have been used in other studies of SES (Gump, Matthews, & Raikkonen, 1999). If parents were not employed, this variable was coded as missing, as these families were not considered to have an occupational status score. As an indicator of income, we asked about family income before taxes, from all sources, over the past 12 months. As an indicator of assets, parents were asked about family savings (liquid assets that could be used in an emergency). Categories of responses were created for the income and savings questions. Missing values occurred because sometimes a parent did not know the amount their family had in savings or made in income, and sometimes a parent chose not to respond.

Subjective perception of SES was measured through the MacArthur Scale of Subjective Social Status (Goodman et al., 2001). The youth version of this measure contains two questions for youth about perceptions of family status and perceptions of youth's school status. As a measure comparable with the aforementioned neighborhood and family indicators, we focused on the question of perceived family status. Adolescents were presented with a picture of a ladder and asked to place their family in comparison with others in society on the ladder, with higher rungs indicating higher status.

Physiological Measures

Blood pressure. We monitored systolic blood pressure (SBP) and diastolic blood pressure (DBP) using a Dinamap Pro 100 automated blood pressure monitor (Critikon, Tampa, FL) with a standard occluding cuff on the participant's right arm. SBP and DBP measures were taken three times during the last 5 min of a 10-min rest period. Data on SBP and DBP were obtained in all three studies.

Heart rate (HR). We measured HR through EKG monitoring. An EKG signal was transduced using two active Meditrace SF450 disposable silver/silver chloride electrodes (Kendall-LTP, Chicopee, MA) placed on each side of the abdomen and a ground electrode beside the navel. The EKG signal was filtered and amplified by the Biopac MP100 system (Biopac Systems, Santa Barbara, CA). HR was monitored continuously during the last 5 min of the 10-min rest period. Data on HR were obtained in all three studies. One participant's values were lost because of equipment malfunction.

Cortisol. Salivary cortisol samples were collected from participants as described below. Samples were spun at 3000 rpm for 5 min and then frozen at $-70°C$ until assay. The assay involved time-resolved immunoassay with fluorescence detection using a biotin-CORT conjugate as a tracer and a streptavidin eurpopium label. This assay has a sensitivity of 0.43 nM and assay CVs of less than 10%. Data on cortisol were obtained in Studies 1 and 2. Three participants did not generate sufficient saliva to obtain detectable readings and were thus coded as missing.

BMI. Height and weight were measured on a standard medical-grade balance beam scale, and BMI was computed from these two variables. Data on BMI were obtained in all three studies.

Psychological Measures

Cognitive Appraisal and Understanding of Social Events (CAUSE) videos. We used the CAUSE videos (Chen & Matthews, 2003) as a measure of threat perception during ambiguous events. The videos test differences in adolescents' perception of threat when an ambiguous situation (video) is kept constant across participants. The video called "Shopping" depicts a teenager browsing in a department store with a potentially suspicious saleswoman and security guard nearby. Participants watched the video and then were interviewed about their interpretations. Responses were audiotaped and coded on a 5-point scale, with higher scores indicating greater threat. Responses can be reliably coded, with two raters agreeing within 1 point 89%–94% of the time (Chen, Langer, Raphaelson, & Matthews, 2004; Chen et al., 2003). Twenty percent of the audiotapes were double coded for reliability. Raters were blind to participant SES. CAUSE data were obtained in all three studies.

Discrimination questionnaire. This questionnaire consists of 10 items that ask about day-to-day experiences with discrimination (e.g., being treated with less respect than other people) and asks participants to indicate how often they experience these events on a 4-point scale ranging from *never* (1) to *often* (4). This scale is applicable to both Caucasian and African American participants because it does not ask only about racial discrimination. This scale has been demonstrated to have good internal consistency and validity (Williams, Yu, Jackson, & Anderson, 1997). Higher scores indicate greater perceived discrimination. Data on discrimination were obtained in all three studies.

Hostility. The Cook–Medley Hostility Scale consists of 27 items rated as either true or false (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989). Items probe cynicism, hostile affect, and aggressive responding. Higher scores indicate higher hostility. This scale has good internal consistency (Woodall & Matthews, 1993). Hostility data were obtained in Studies 1 and 3.

Optimism. Optimism was measured by the Life Orientation Test—Revised (LOT–R; Scheier, Carver, & Bridges, 1994). This questionnaire has been shown to have good psychometric properties (Scheier et al., 1994). Participants rate the extent to which they agree with 10 items regarding expectancies for positive versus negative outcomes on a 5-point scale. Higher scores indicate greater optimism. Data on optimism were obtained in Studies 2 and 3.

Self-esteem. We used Rosenberg's Self-Esteem Scale (Rosenberg, 1965) to measure self-esteem. This questionnaire consists of 10 statements regarding global attitudes about the self. Participants rate the extent to which they agree with each item on a 4-point scale. This scale has good psychometric properties (Rosenberg, 1965). Higher scores indicated greater self-esteem. Data on self-esteem were obtained in Study 3.

Perceived control. We assessed perceived control with the Self-Mastery Scale (Pearlin & Schooler, 1978). This questionnaire consists of seven statements regarding how much an individual perceives having

control over things in his or her life. Items are rated on a 4-point scale, with higher scores indicating greater perceived control. The measure has good psychometric properties (Pearlin et al., 1978). Data on perceived control were obtained in Study 2.

Procedures

All adolescents and parents were required to sign a consent form before participation in the study. This study was approved by the Institutional Review Board at Washington University. Testing took place after school hours, typically in the late afternoon. Parents were interviewed about family SES information. Adolescents were seated in an individual testing room, and the three EKG electrodes were applied. The blood pressure cuff was placed on the upper aspect of the participant's right arm with the microphone placed above an area where the brachial artery could be palpated. During the recorded baseline rest period (which occurred after approximately 15 min of rest while machines were tested), blood pressure and HR were monitored during a 10-min rest period, and values were averaged over the final 5 min. At the end of the rest period, we obtained a sample of salivary cortisol by having each adolescent place a cotton roll into his or her mouth for 1 min and then putting the roll into a salivette tube for storage. Following these procedures, adolescents participated in a variety of laboratory stressor tasks (not reported here). At the end of the study, they completed the battery of psychological measures described earlier.

Results

Characteristics of the Sample

Sample characteristics and descriptive information on study variables are presented in Table 1. For all analyses described later, the neighborhood education (percent with less than a high school education) and neighborhood occupation (percent unemployed) were reverse scored so that all SES measures would be consistent

in having higher numbers indicate higher SES. Correlations among the different types of SES measures were first tested. Neighborhood SES measures were significantly associated with one another (rs ranged from .57 to .93), ps < .001), and family SES measures were significantly associated with one another (rs ranged from .45 to .68, ps < .001). Neighborhood SES variables were significantly associated with family SES variables (rs ranged from .28 to .60, ps < .001). Adolescents' subjective perception of family status significantly correlated with family SES (rs ranged from .15 to .27, ps < .01) but not with neighborhood SES (rs ranged from −.02 to .06, ns).

Correlations Between SES Measures and Adolescent Physical Health Outcomes

We conducted partial correlations between SES and BMI, controlling for age and gender. Lower neighborhood and lower family SES were both associated with higher adolescent BMI. Lower neighborhood education, employment status, income, and assets were all associated with higher adolescent BMI, rs ranging from −.28 to −.34, ps < .001. Similarly, lower family education, occupational status, income, and assets were all associated with higher adolescent BMI; rs ranged from −.11 to −.35, ps < .05. In contrast, adolescent subjective perception of family status was not associated with BMI, p > .2.

We conducted partial correlations between SES and log-transformed cortisol values, controlling for time of day. Lower neighborhood and (in some cases) lower family SES were both associated with lower basal cortisol levels. Lower neighborhood education, employment status, income, and assets were all associated with lower adolescent cortisol; rs ranged from .21 to .28, ps < .01. Lower family income and savings also were associated with

Table 1
Descriptive Information for Study Variables

Variable	n	M (SD)	Range
% of neighborhood < high school education	315	13.6 (12.7)	0–57
% of neighborhood unemployed	315	5.2 (6.2)	0–38
Median family income in neighborhood	315	$65,000 ($32,000)	$16,000–$160,000
Median value owner-occupied houses in neighborhood	315	$140,000 ($86,000)	$26,000–$400,000
Family years of education	315	15.1 (2.2)	10–27
Family occupation (scale of 1 to 9)	310	6.2 (1.8)	1–9
Family income (scale of 1 to 6)	311	3.4 (1.6)	1–6
Family savings (scale of 1 to 7)	295	3.8 (2.3)	1–7
Subjective status (scale of 1 to 10)	315	6.4 (1.3)	2–10
BMI	315	24.9 (5.9)	16–52
Cortisol (nmol/L)	212	9.4 (13.6)	8–100
SBP (mmHg)	315	111.5 (10.0)	83–141
DBP (mmHg)	315	61.4 (6.5)	46–78
HR (bpm)	311	73.4 (10.8)	46–105
Threat perception	314	0.02 (1.2)	−2–2
Discrimination	315	26.7 (8.3)	10–40
Hostility	213	13.2 (4.3)	2–22
Optimism	213	15.2 (3.7)	2–24
Self-esteem	100	55.0 (9.8)	31–70
Control	114	22.3 (2.5)	16–28

Note. For occupation, Category 6 corresponds to technician/semiprofessional. For family income, Category 3 corresponds to $50,000–$75,000. For family savings, Category 3 corresponds to $5,000–$10,000. In comparison, median income for a four person family in 2000 was $62,228 (U.S. Census Bureau). Average family size in our sample was 4.02. BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR (bpm) = heart rate (in beats per minute).

lower adolescent cortisol; *r*s ranged from .20 to .21, *p*s < .01. In contrast, adolescent subjective perception of family status was not associated with cortisol, *p* > .5.

In contrast, few associations were present for blood pressure and HR. Lower family savings was associated with higher adolescent basal SBP, *r* = −.13, *p* < .05. In addition, lower family savings was associated with higher adolescent basal HR, *r* = −.12, *p* < .05. (See Table 2.)

Simultaneous Regression Analyses

Next, we conducted simultaneous regression analyses to compare the effects of neighborhood versus family SES. Subjective SES was not included in these analyses, given that there were no significant bivariate associations with health. Cardiovascular measures also were not included in simultaneous regression analyses, given the few bivariate associations that we found. In determining which level of SES (neighborhood or family) had stronger effects on adolescent health, we included comparable indicators of each in simultaneous analyses; thus, we tested the effects of neighborhood education versus family education, neighborhood employment versus family employment, neighborhood income versus family income, and neighborhood assets versus family assets in separate simultaneous regression analyses. Including multiple neighborhood (or family) SES measures together in one simultaneous regression equation would have tested the question of whether one neighborhood indicator contributed beyond other neighborhood indicators, rather than address the question of interest to us: whether neighborhood SES contributes beyond the effects of family SES or vice versa. See Table 3 for a summary of the results.

For adolescent BMI, neighborhood education and employment status remained a significant predictor beyond the effects of family education and occupation. Neighborhood SES independently accounted for 9.2%–10.6% of the variance in BMI. In contrast, family education and occupation were not significant predictors beyond neighborhood SES. For income and asset measures, both family and neighborhood SES independently predicted adolescent

Table 3

Simultaneous Regression Analyses of Neighborhood and Family Socioeconomic Status (SES); Variables Predicting Adolescent Physiological Outcomes

Variable	BMI			Cortisol		
	n	β	*p*	*n*	β	*p*
Neighborhood education	315	−.34	< .001	211	.23	<.01
Family education	315	.00	*ns*	211	−.01	*ns*
Neighborhood employment	310	−.34	<.001	208	.19	<.01
Family occupational status	310	−.02	*ns*	208	.07	*ns*
Neighborhood income	311	−.17	<.01	207	.25	<.01
Family income	311	−.22	<.01	207	.08	*ns*
Neighborhood assets	295	−.15	<.05	192	.20	<.025
Family assets	295	−.27	<.001	192	.10	*ns*

Note. Simultaneous regression analyses included the comparable family and neighborhood SES variables together in predicting adolescent physiological outcomes. Subjective SES was not included in these analyses because it was not associated with physiological outcomes in bivariate correlations. The body mass index (BMI) analyses include age and gender as covariates. The cortisol analyses include time of day as a covariate and used log-transformed cortisol values. For all SES measures, higher scores indicate higher SES.

BMI. Beyond the effects of family SES, neighborhood SES accounted for 1.5%–2% of the variance in BMI, whereas family SES accounted for 3.5%–5.2% of the variance in BMI after partialing out the effects of neighborhood SES.

For adolescent cortisol levels, neighborhood SES remained a significant predictor beyond the effects of family SES. Neighborhood education, employment, income, and assets predicted adolescent cortisol levels independent of family SES effects. This independent effect of neighborhood SES accounted for 2.9%–4.7% of the variance in cortisol. In contrast, family education,

Table 2

Correlations Between Socioeconomic Status (SES) and Physiological Variables

Variable	BMI[a]		Cortisol[b]		SBP		DBP		HR	
	r	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*
Neighborhood										
Education	−.34***	315	.24**	212	−.05	315	.02	315	−.01	314
Employment	−.34***	315	.21**	212	−.08	315	.01	315	.01	314
Income	−.28***	315	.28***	212	−.06	315	−.01	315	−.04	314
Housing value	−.28***	315	.24**	212	−.10	315	−.04	315	−.04	314
Family										
Education	−.14*	315	.09	212	−.07	315	−.04	315	−.07	314
Occupation	−.11*	310	.12	209	−.05	310	−.10	310	−.04	310
Income	−.31***	311	.21***	208	−.05	311	−.04	311	−.08	310
Savings	−.35***	295	.20**	193	−.13*	295	−.05	295	−.12*	294
Subjective status	−.06	315	−.01	212	.09	315	.02	315	−.07	314

Note. As described in the Results section, education (% of people with < high school education) and employment (% of people unemployed) at the neighborhood level are reverse coded so that for all SES variables, higher numbers indicate higher SES. BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate.
[a] correlations control for age and gender. [b] Correlations control for time of day of saliva sample.
* *p* < .05. ** *p* < .01. *** *p* < .001.

occupational status, income, and savings were not significant predictors of adolescent cortisol after controlling for neighborhood effects.

Correlations Between SES Measures and Adolescent Psychological Measures

Next, we tested associations of psychological variables with neighborhood, family, and subjective SES. (See Table 4.) Negative psychological characteristics and experiences were associated with neighborhood and family SES but not with subjective SES. Lower neighborhood education, employment status, income, and assets were all associated with higher levels of hostility; rs ranged from $-.18$ to $-.32$, ps $< .01$. Lower family occupation, income, and assets were all associated with higher levels of hostility; rs ranged from $-.23$ to $-.29$, ps $< .01$. Adolescent subjective perception of family status was not associated with hostility, $p > .5$.

The same patterns held for perceived discrimination. Lower neighborhood education, employment status, income, and assets were all associated with higher levels of discrimination; rs ranged from $-.23$ to $-.29$, ps $< .001$. Lower family education, occupation, income, and assets were all associated with higher levels of discrimination; rs ranged from $-.19$ to $-.30$, ps $< .001$. Adolescent subjective SES was not associated with discrimination, $p > .2$.

The same patterns also held for perceived threat during ambiguous situations. Lower neighborhood education, employment status, income, and assets were all associated with higher levels of perceived threat; rs ranged from $-.14$ to $-.18$, ps $< .05$. Lower family education, occupation, income, and assets were all associated with higher levels of perceived threat; rs ranged from $-.19$ to $-.23$, ps $< .01$. Subjective SES was not associated with threat perception, $p > .5$.

In contrast, positive psychological variables were associated with subjective, but not objective, SES variables. Higher subjective perception of family status was associated with higher levels of adolescent optimism, higher self-esteem, and higher perceived control; rs ranged from .19 to .33, ps $< .05$. In contrast, none of the

neighborhood or family SES variables were associated with adolescent optimism, self-esteem, or perceived control.

Simultaneous Regression Analyses

Next, we conducted simultaneous regression analyses to compare the effects of neighborhood and family SES on adolescent negative psychological variables. Subjective SES was not included in these analyses, given that there were no significant associations. Positive psychological variables were not tested using simultaneous regression analyses, given that only subjective, and not family or neighborhood SES, was associated with these variables. Regression analyses for psychological variables were conducted in an identical manner to analyses described above for physical health variables. (See Table 5.)

For adolescent hostility, neighborhood education significantly predicted adolescent hostility beyond the effects of family education. In contrast, family education did not predict adolescent hostility after controlling for neighborhood effects. For income and asset measures, the opposite pattern emerged. Family income and assets predicted adolescent hostility independent of neighborhood income and assets. In contrast, neighborhood income and assets no longer predicted adolescent hostility after controlling for family effects. For occupation, both neighborhood employment and family occupation independently predicted adolescent hostility. Across these analyses, neighborhood SES accounted for 4.5%–8.4% of the variance in hostility beyond the effects of family SES, whereas family SES independently accounted for 2.4%–4.5% of the variance in hostility.

For adolescent-reported perceived discrimination, both neighborhood and family SES remained independent predictors after controlling for the other; that is, both neighborhood and family SES contributed unique variance in predicting discrimination. This pattern held true for each of the types of SES measures (education, occupation, income, and assets). Family SES independently accounted for 1.0%–2.4% of the variance in discrimination, whereas neighborhood SES independently accounted for 2.5%–3.5% of the variance in discrimination.

Table 4

Correlations Between Socioeconomic Status (SES) and Psychological Variables

Variable	Hostility		Discrimination		Threat perception		Optimism		Control		Self-esteem	
	r	n	r	n	r	n	r	n	r	n	r	n
Neighborhood												
Education	$-.32$***	200	$-.23$***	315	$-.18$**	314	.02	215	.08	115	$-.10$	100
Employment	$-.28$***	200	$-.23$***	315	$-.14$*	314	.04	215	.13	115	$-.08$	100
Income	$-.18$**	200	$-.29$***	315	$-.17$**	314	.04	215	.01	115	$-.06$	100
Housing value	$-.20$**	200	$-.28$***	315	$-.14$*	314	.04	215	.00	115	$-.04$	100
Family												
Education	$-.14$	200	$-.21$***	315	$-.23$***	314	.03	215	$-.06$	115	$-.18$	100
Occupation	$-.27$***	197	$-.19$***	310	$-.22$***	309	.08	211	$-.02$	113	.04	98
Income	$-.23$**	198	$-.24$***	311	$-.21$***	310	.09	214	$-.03$	114	$-.03$	100
Savings	$-.29$***	183	$-.30$***	295	$-.19$**	294	.10	213	.07	114	.02	99
Subjective status	$-.05$	200	.07	315	.00	314	.33***	215	.19*	115	.22*	100

Note. As described in the Results section, education (% of people with $<$ high school education) and employment (% of people unemployed) at the neighborhood level are reverse coded so that for all SES variables, higher numbers indicate higher SES.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5
Simultaneous Regression Analyses of Neighborhood and Family Socioeconomic Status (SES) Variables Predicting Adolescent Negative Psychological Variables

Variable	Hostility			Discrimination			Threat perception[a]		
	n	β	p	n	β	p	n	β	p
Neighborhood education	200	−.32	< .001	315	−.18	<.01	314	−.10	*ns*
Family education	200	−.01	*ns*	315	−.13	<.05	314	−.19	<.01
Neighborhood employment	197	−.22	<.01	310	−.19	<.01	309	−.09	*ns*
Family occupation	197	−.22	<.01	310	−.14	<.05	309	−.20	<.01
Neighborhood income	198	−.09	*ns*	311	−.22	<.01	310	−.07	*ns*
Family income	198	−.18	<.05	311	−.12	.07	310	−.17	<.05
Neighborhood assets	183	−.11	*ns*	295	−.21	<.01	294	−.05	*ns*
Family assets	183	−.23	<.01	295	−.18	<.01	294	−.16	<.05

Note. Simultaneous regression analyses included the comparable family and neighborhood SES variables together in predicting adolescent psychological variables. Subjective SES was not included in these analyses because it was not associated with these psychological variables in bivariate correlations. For all SES measures, higher scores indicate higher SES.
[a] Perception of threat in ambiguous situations.

For adolescent perception of threat during ambiguous situations, family, but not neighborhood, SES remained a significant predictor in regression analyses. Family education, occupational status, income, and assets predicted adolescent threat perception beyond the effects of neighborhood SES (independently accounting for 1.9%–3.7% of the variance). In contrast, neighborhood education, employment, income, and assets did not predict threat perception after controlling for family SES effects.

Discussion

The results of this study highlight the importance of neighborhood context in adolescent physical health outcomes. Neighborhood SES measures were associated with adolescent BMI beyond the contribution of family SES. In contrast, family prestige SES (education, occupation) did not contribute independently to adolescent BMI beyond the effects of neighborhood prestige variables. Family resources (income, savings) did account for unique variance in adolescent BMI after controlling for neighborhood resources. These findings indicate that both the neighborhood context and family resources play a role in adolescent BMI.

Neighborhood resources may play a role in adolescent BMI in that the availability of parks and sidewalks may determine the extent to which adolescents are able to engage in outdoor physical activity in their neighborhood. In addition, the availability of healthy affordable food options in neighborhood grocery stores may play a role in adolescents' diet. Previous research has shown that lower SES neighborhoods have fewer parks and grocery stores with fewer and more expensive healthy food options (Williams & Collins, 2001). Neighborhood prestige may be related to adolescent BMI in indicating social norms with respect to health behaviors. Communities where neighbors possess greater awareness and knowledge about health behaviors may lead to community role models and social norms for physical activity and diet that promote lower BMI among adolescents in those neighborhoods (Jencks et al., 1990).

Family resources may relate to adolescent BMI in that they indicate the extent to which families can afford to purchase healthy food options for their children. Family resources also may indicate the extent to which families can financially support their children participating in sports and other physical activities. In contrast, the fact that family prestige was not related uniquely to adolescent BMI suggests that the ability to act on family knowledge about healthy behaviors may be constrained by available resources; that is, knowledge about healthy practices may not get translated into healthy behaviors if families lack the resources to facilitate these behaviors.

Previous research has documented associations between low SES and higher obesity rates (see Sobal & Stunkard, 1989, for a review). In children and adolescents, multiple studies have demonstrated that lower family SES is associated with higher BMI and obesity levels (Burke, Beilin, & Dunbar, 2001; De Spiegelaere, Dramaix, & Hennart, 1998; Evans, 2003; Gliksman, Dwyer, & Wlodarczyk, 1990; Goodman, 1999). One of the few comparative SES studies revealed that both family SES and perceived school status remained independent predictors of adolescent obesity, whereas perceived family status did not (Goodman et al., 2001). These findings are consistent with the present study in that adolescents' perceived family status did not predict obesity levels, whereas objective family SES did; in addition, our study documented effects of neighborhood SES on obesity-related indicators.

Second, neighborhood but not family SES predicted adolescents' basal cortisol levels. Lower neighborhood SES was associated with lower basal cortisol levels. Cortisol is a hormone released by the hypothalamic pituitary adrenal axis and is known to be responsive to stress. Whereas acute stress temporarily increases cortisol levels (Dickerson & Kemeny, 2004; Kirschbaum & Hellhammer, 1989), evidence suggests that cortisol levels sometimes rebound below normal after persistent stress (Heim, Ehlert, & Hellhammer, 2000). For example, various types of chronic stressors have been associated with either blunted cortisol levels or

flatter cortisol rhythms throughout the day (Caplan, Cobb, & French, Jr., 1979; Miller, Cohen, & Ritchey, 2002; Pruessner, Hellhammer, & Kirschbaum, 1999; Yehuda, 1997). In the present study, living in lower neighborhood-SES environments may mean facing persistent and ongoing stressors that, over time, lead to blunted cortisol levels.

However, it should be noted that, although some models of chronic stress postulate hypocortisolism profiles, others predict heightened cortisol responses to stress (see McEwen, 1998, for a discussion). Some previous childhood studies have found that low SES (e.g., poverty status) is associated with higher cortisol levels in preteen children (Evans, 2003; Evans & English, 2002). It may be that dysregulation of cortisol profiles occurs in different directions, depending on the nature and duration of the stressor. For example, Lupien and colleagues found that cortisol samples taken at the start of the school day were higher in low-SES children (Lupien et al., 2000). However, additional testing revealed that this pattern held only for younger children (ages 6–10), whereas adolescent cortisol profiles did not differ significantly by SES and, in fact, showed signs of reversing the SES patterns during adolescence (Lupien et al., 2001). In this case, cortisol patterns may shift over time as stress experiences accumulate. Our data suggest that, by the high school years, low SES may be better characterized by blunted basal cortisol levels.

In contrast to BMI and cortisol, adolescent blood pressure and HR showed few associations with SES. Only lower family savings was related to higher basal SBP and HR. This pattern of few relationships between SES and blood pressure is consistent with previous research finding few or inconsistent patterns, most frequently during adolescence (Chen et al., 2002; Evans, 2003; Evans, Lepore, Shejwal, & Palsane, 1998; Jackson, Treiber, Turner, Davis, & Strong, 1999; Leino et al., 1996; West, 1997; West & Sweeting, 2004). In contrast, in adulthood, there is good evidence for an inverse relationship between SES and cardiovascular risk factors, as well as cardiovascular disease (Colhoun, Hemingway, & Poulter, 1998; Kaplan & Keil, 1993), suggesting that the effects of SES on the cardiovascular system may take longer to emerge than for other health outcomes.

In summary, with respect to adolescent physical health outcomes, neighborhoods appear to exert an important influence on health. This conclusion has been suggested in the adult health literature (MacIntyre et al., 1993) but has not received as much discussion in the child physical health literature. It is also consistent with the child developmental literature, where an extensive literature has shown that low-SES neighborhoods are detrimental to child academic and social outcomes (Brooks-Gunn et al., 1993; Brooks-Gunn, Duncan, & Aber, 1997; Evans, 2004; Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; Leventhal et al., 2000; McLoyd, 1998). In addition, studies of mental health outcomes have found that both neighborhood and family SES independently contribute to adolescent depression (Goodman, Huang, Wade, & Kahn, 2003). Thus the present study extends important previous work regarding neighborhood influences to the physical health domain.

With respect to adolescent psychological characteristics and experiences, effects came from different levels of SES, depending on the outcome. In general, psychological characteristics related to the appraisal or perception of stress were related to family SES variables. Adolescents' perception of threat during ambiguous situations was related to lower family SES beyond the effects of neighborhood SES. In addition, adolescents' perceptions of discrimination and perceptions that others cannot be trusted (hostility) were independently related to lower family SES. The findings of associations of family SES with discrimination and hostility are similar to patterns seen in adulthood (Barefoot et al., 1991; Clark, Anderson, Clark, & Williams, 1999; Scherwitz, Perkins, Chesney, & Hughes, 1991). Overall, these patterns suggest that families play a role in shaping how adolescents learn to interpret stresses in their lives.

Psychological experiences that can be characterized partly by the occurrence of stressors were linked to neighborhood SES. For example, higher discrimination was independently associated with lower neighborhood SES. Discrimination may comprise two dimensions—both the occurrence of prejudiced acts (stressors) and the perception by the individual of having experienced discrimination. This would fit with the pattern of both neighborhood and family SES independently predicting discrimination in the present study. In contrast, perception of threat during ambiguous situations is made up of only one dimension—perception (given that the stressor presentation is equivalent across all individuals). In this case, threat perception was independently predicted by only family, and not neighborhood, SES.

Last, higher hostility was predicted by lower neighborhood prestige after controlling for family prestige. Hostility, like discrimination, may comprise both a perception and the occurrence of mistreatment by others. Neighborhood prestige, in particular, may be related to hostility because this aspect of SES relates to the social connections in a neighborhood (e.g., social trust), whereas neighborhood resources relate more to physical characteristics. Similarly, one previous study found that both neighborhood and family SES were independently related to hostility in children (Gump et al., 1999).

Among all physical and psychological variables, subjective perception of SES was related only to positive psychological traits. Adolescents who perceived themselves to have higher family status also had higher levels of optimism, self-esteem, and perceived control. It is unclear whether perception of social status drives the development of positive psychological characteristics or whether positive psychological traits shape adolescents' perceptions of status. Nonetheless, it suggests that subjective social status relates to a unique realm of well-being in adolescence. However, it should be noted that one previous study found relationships between subjective status and adolescent depression and obesity (Goodman et al., 2001).

One limitation of the present study could be that we relied on adolescents to self-refer to the studies. Thus, it is possible that participation rates varied by SES, which may have affected the patterns of results that we found. However, if participation predominantly came from families who were more motivated to participate in a research study (and perhaps higher in SES), one might expect the variability in our dependent variables to be more restricted and thus expect associations to be weaker than what would be observed in a more representative sample.

Second, effect sizes (percent variance accounted for by SES) were modest in this study; however, it is important to keep in mind that the effect sizes reported were for the unique contribution of one type of SES measure beyond a second type of SES. Given that SES measures share variance, these modest effect sizes for inde-

pendent effects are not unexpected. It should also be noted that the neighborhood measures used in this study, while similar to those used in other studies, nonetheless are at best broad representations of the characteristics of neighborhoods.

In addition, the study was limited in that not all measures were completed by all participants. Because we pooled data from three different studies of adolescents, sample sizes varied across analyses. Future studies that assess the above constructs consistently across a large sample of adolescents would provide information about the reliability of our findings. A further limitation is the single laboratory assessment of biological measures. This is not unusual for studies relating SES to health; nonetheless, future studies that are able to collect multiple cortisol samples across days (and include time of awakening as a measure), or ambulatory blood pressure and HR data, will allow researchers to test how daily life physiological measures relate to SES. This study was cross-sectional, and as such we cannot make claims of causality. In particular, issues of directionality for associations between subjective SES and psychological measures are difficult to discern.

In summary, this study is the first that we know of to document that, beyond the effects of the family environment, the neighborhood in which adolescents live is related to physical health outcomes. In addition, both family and neighborhood SES predicted adolescent psychological outcomes. Specifically, perceptions of stress are linked to family SES. Psychological characteristics or experiences that are related to both the occurrence and perception of stressors are linked to both family and neighborhood SES. Overall, these findings suggest the importance of understanding influences at the individual, family, and neighborhood levels for interventions aimed at reducing health disparities early in life. For example, for physical health outcomes, interventions that work toward changing neighborhood characteristics (e.g., available resources, safety of neighborhood) may make a bigger impact than working with families and should be considered in the goal of reducing health disparities among youth in our society.

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