Socioeconomic Status and Health: A Micro-level Analysis of Exposure and Vulnerability to Daily Stressors*

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This study examines the interconnections among education—as a proxy for socioeconomic status—stress, and physical and mental health by specifying differential exposure and vulnerability models using data from The National Study of Daily Experiences (N = 1,031). These daily diary data allowed assessment of the social distribution of a qualitatively different type of stressor than has previously been examined in sociological stress research—daily stressors, or hassles. Moreover, these data allowed a less biased assessment of stress exposure and a more micro-level examination of the connections between stress and health by socioeconomic status. Consistent with the broad literature describing socioeconomic inequalities in physical and mental health, the results of this study indicated that, on any given day, better-educated adults reported fewer physical symptoms and less psychological distress. Although better educated individuals reported more daily stressors, stressors reported by those with less education were more severe. Finally, neither exposure nor vulnerability explained socioeconomic differentials in daily health, but the results clearly indicate that the stressor-health association cannot be considered independent of socioeconomic status.

Stress exposure and vulnerability play a central role in the sociological study of socioeconomic differentials in physical and mental health (Aneshensel 1992; Baum, Garofalo, and Yali 1999; Kessler 1979; Pearlin 1989). Individuals in lower socioeconomic groups shoulder a disproportionate amount of both acute and chronic stressful events (Turner and Lloyd 1999; Turner, Wheaton, and Lloyd 1995), and there is a well-established link between higher levels of stress and decreased physical and mental health (Cohen and Herbert 1996; Kelly, Hertzman, and Daniels 1997; Theorell 1982). Indeed, differential exposure and vulnerability to stress are among the primary hypotheses offered by sociologists to

explain the socioeconomic status-health association (Evans, Barer, and Marmor 1994; House and Williams 2000; Wilkinson 1996).

The study of stress as a mediator of the socioeconomic status and health relationship remains encumbered, however. First, previous studies have overlooked daily stressors, a form of stress that can and should be differentiated from chronic or acute stressors because of their effects on health (Wheaton 1994). Moreover, while the study of acute and chronic stress provides a wide-angle view of general conditions that are socially structured, daily stressors capture the day-to-day experiences that are contingent upon, and unfold within, a broader context shaped by socioeconomic status (Aneshensel 1992; Krieger, Williams, and Moss 1997). Next, previous research examining socioeconomic status, stress, and health suffers from a type of ecological fallacy (Robinson 1950), because inferences have been made about within-person processes (an individual's daily stressful experiences undermines her/his health) from studies using between-person designs (Affleck, Zautra, Tennen, and Armeli 1999). Finally, the study of stress as a mediator of the status-health relationship frequently does not examine both physical and mental health, and a limited range of outcomes is a standing limitation in vulnerability studies of stress and health (Aneshensel 1992). In this study, we seek to attenuate these limitations by examining stressor exposure and vulnerability models in daily data obtained from the first nationally representative study of daily stressful experiences (National Study of Daily Experiences).

THEORETICAL AND EMPIRICAL BACKGROUND

Conceptual Underpinnings

The "life stress hypothesis," including both differential exposure and vulnerability, is one of the major explanations invoked to explain health disparities such as those exemplified by socioeconomic status (Baum et al. 1999; House and Williams 2000). The exposure component argues that lower status individuals are subjected to quantitatively more physical, psychological, and social stressors than their higher status counterparts (Dohrenwend 1973; Pearlin 1989), and this higher level of exposure

accounts for the increased incidence of morbidity and mortality among members of disadvantaged groupings. The vulnerability component suggests that disadvantaged individuals are more vulnerable to the negative effects of life stressors than more advantaged individuals because they have fewer or less effective coping resources (Kessler 1979; Kessler and Cleary 1980; Kohn 1972), or because their stressors are qualitatively more potent.

Implicit in discussions of exposure and vulnerability is acknowledgement that stressors can take a variety of forms (Pearlin 1989; Wheaton 1994). The first form of stressor is characterized by specific or discrete life events, and they are believed to stimulate an immediate and intense physiological response that returns to baseline with successful adaptation (for comprehensive discussion of different physiological stress response scenarios see McEwen 1998). Chronic or enduring experiences, such as unemployment or financial hardship (Catalano and Dooley 1983) characterize a second form of stressor, and a final type of stressor reflects frequent, perhaps minor "hassles" (Kanner, Coyne, Schaefer, and Lazarus 1981). The physiological response to these latter two forms of stressors can be characterized by heightened levels of physiological arousal that endure over time or frequent physiological spikes, both of which lead to extensive wear and tear over time (McEwen 1998).

The importance of daily hassles as a unique form of stress (Kanner et al. 1981; Wheaton 1994) has not been fully appreciated in studies of socioeconomic disparities in health. There is, for example, a long history of research examining life events and several reviews suggesting that socioeconomic disparities in health are attributed more to differential vulnerability to life events than to differential exposure (Aneshensel 1992; Kessler and Cleary 1980; Kessler, Price, and Wortman 1985; Thoits 1983). More recently, scholars have demonstrated that lower status individuals are exposed to more chronic stressors than their higher status counterparts (Turner et al. 1995), and that the personal and social resources involved in the stress process are less available to lower status individuals (Pearlin 1989; Turner and Lloyd 1999; Wheaton 1983). By contrast, a descriptive epidemiology of daily stressors and explicit examinations of differential vulnerability to daily stressors by

socioeconomic status are absent in the literature (Eckenrode and Bolger 1995).

The study of daily stressors, however, offers unique insight into the ordinary circumstances that may sustain and exacerbate social inequalities in health. First, it is clear that daily stressors have potent effects on physical and mental health (Almeida and Kessler 1998; Almeida, Wethington, and Kessler 2002; Bolger, DeLongis, Kessler, and Schilling 1989; Delongis, Folkman, and Lazarus 1988; Lu 1991), and some studies suggest that daily stressors have the strongest effects on health symptoms and health states (Jandorf, Deblinger, Neale, and Stone 1986; Weinberger, Hiner, and Tierney 1987). Next, although the magnitude of daily stressor effects is partially attributed to indirect effects from chronic or acute stressors, daily stressors do also exert additive, independent effects on physical and mental health (Wheaton 1994); thus, the additional and possible cumulative toll of daily hassles can be substantial. Moreover, there is evidence that the effects of daily stressors on physical and mental health are exacerbated by chronic stressors such as overcrowding, poor neighborhood quality (Caspi, Bolger, and Eckenrode 1987; Lepore, Evans, and Palsane 1991), or acute life events (Burks and Martin 1985). In summary, studying daily stressors provides an important microlevel complement to wide angle studies of socioeconomic status, stress, and health because, as Wheaton (1994) contends, "daily stressors capture a level of social reality that is untapped by other conceptualizations of stress, and they offer insight into the mundane realities of daily life" (p. 87) that characterize social disadvantage and may contribute to inequalities in health.

Theoretical and Methodological Challenges

Although the study of daily stress is not new (for a review, see Eckenrode and Bolger 1995), there are several theoretical and methodological challenges to examining the role of daily stressors in socioeconomic health disparities. First, it is challenging to characterize the linkage between socioeconomic status and exposure to daily stressors. On one hand, theory and evidence suggests that lower status individuals would bear a disproportionate burden of daily hassles than higher status individuals (Pearlin 1989). For example, over 40 percent of the variance in daily hassles can be attributed to previous or ongoing stressors (Wheaton 1994); thus, lower status individuals should report more daily stressors because they have more stressful life events and more chronic stressors (Turner et al. 1995). On the other hand, stressors frequently arise from role-related transactions between individuals and their environments (Aneshensel 1992; Turner and Wheaton 1995), and, to the extent that higher status individuals are engaged in more key roles or have higher expectations from their roles, they should report more daily stressors than their lower status counterparts. In short, to the extent that daily hassles can arise from socially structured hardships (e.g., poverty) as well as status-based responsibilities or privileges (e.g., supervising a large staff), it remains an empirical question whether daily hardships systematically vary by socioeconomic status (Eckenrode and Bolger 1995).

Measurement is another challenge confronting the study of daily stressors and their implications in socioeconomic inequalities in health. Checklist formats, such as the Daily Hassles Scale (Kanner et al. 1981), are most commonly used to study daily stressors (Eckenrode and Bolger 1995); unfortunately, stress measures that use checklist formats, daily or otherwise, tend to be problematic (Thoits 1983; Wethington, Brown, and Kessler 1995). First, checklist measures are not sensitive to overall stressor severity unless they are specifically adapted to probe the meaning and detail of the stressor (Wethington et al. 1995). Foul weather, for example, may be an unpleasant nuisance to a business professional, but it can be dangerous or reduce personal income for an outdoor laborer. Thus, the severity of the stressor is likely to be linked to social status and health, even if the stressor itself is not. Another problem with checklist measures is that they do not adequately cover the broad domain of daily stressors, which could lead to artifactual biases in estimates of stressor exposure (Thoits 1983). Finally, unless employed within a repeated measures design, checklist measures rely upon retrospective reports of stressful experiences (e.g., Daily Hassles Scale requires consideration of the past month). Apart from potential for recall biases in self-reports (Schwarz 1999), the overlap of retrospective reports of both stressors and health-related outcomes make causal inference difficult, even when using a longitudinal design.

This last issue raises a general limitation of the socioeconomic status, stress, and health literature. Observational designs based on cross-sectional or longitudinal data collected from surveys are well suited for between-person comparisons, such as differential exposure to chronic stressors by socioeconomic status; however, they are not well equipped to assess within-person associations between stress and health and whether these associations differ by a between-person factor such as socioeconomic status. Given ample evidence indicating that people who are under stress suffer more health problems (Cohen and Herbert 1996), within-person associations between stress and health are frequently inferred from between-person designs. However, between-person associations can mask variation in within-person associations in terms of both magnitude and direction (Kenny, Bolger, and Kashy 2002; Tennen, Affleck, Armeli, and Carney 2000), suggesting that inferences from previous studies of somatic or psychiatric vulnerability to stressors by socioeconomic status may be tenuous. In short, it is important to complement previous sociological stress and health research with designs that allow stronger inferences of within-person associations and the between-persons factors that may affect these associations.

Regarding the measurement challenge, Almeida and colleagues (2002) have recently articulated a new approach for studying daily stressors. The Daily Inventory of Stressful Experiences (Almeida et al. 2002) consists of a series of stem questions administered through daily telephone interviews asking whether stressors had occurred in broad domains of life in the past 24 hours (e.g., "since the last time we spoke, did anything happen at home that most people would consider stressful?"), along with a set of interviewer guidelines for probing affirmative responses. Individuals' open-ended responses to the questions and interviewer probes are tape recorded, transcribed, and coded for several characteristics including the nature of the stressor (e.g., interpersonal, risk to health and safety, risk to future plans) as well as subjective and objective appraisals of severity. This investigator-based approach facilitates distinguishing between the stressful event (e.g., conflict with spouse) and the affective response to the stressor (e.g., crying or feeling sad). This approach also does not superimpose an *a priori* set of stressors; rather, it allows respon-

dents to evaluate and report their own experiences. Finally, the probes allow fine distinctions in the appraisal of the stressor.

In summary, previous research examining the "life stress" explanation for socioeconomic disparities in health has overlooked daily stressors as a unique form of stress. A study of exposure and vulnerability to daily stressors by socioeconomic status provides an important complement to studies of acute and chronic stressors because of the important effects daily hassles have on symptoms and health states, and because it would examine a unique "level of social reality" (Wheaton 1994:87) that may sustain or exacerbate health disparities. Although there are several challenges to such a study, tools and data are available to begin exploring this relatively uncharted yet potentially fertile domain. Thus, the primary goals of this study are to offer a micro-level perspective on the role of stress for socioeconomic disparities in health by studying the distribution of daily stressors in the adult population, and to systematically test differential exposure and vulnerability hypotheses linking socioeconomic status and health.

METHODS

Sample

Data for the analyses are from the National Study of Daily Experiences. Respondents were 1,031 adults (562 women, 469 men), all of whom had previously participated in the National Survey of Midlife Development in the United States, a nationally representative telephone-mail survey of 3,032 people, aged 25–74 years, carried out in 1995–1996 under the auspices of the John D. and Catherine T. MacArthur Foundation Network on Successful Midlife. Respondents in the National Study of Daily Experiences were randomly selected from the National Survey of Midlife Development in the United States sample and received $20 for their participation in the project. Over the course of eight consecutive evenings, respondents completed short telephone interviews about their daily experiences. Data collection spanned an entire year (March 1996 to April 1997) and consisted of 40 separate "flights" of interviews, with each flight representing the eight-day sequence of interviews from approximately 38 respondents. The

initiation of interview flights was staggered across the day of the week to control for the possible confounding between day of study and day of week. Of the 1,242 National Survey of Midlife Development in the United States respondents we attempted to contact, 1,031 agreed to participate, yielding a response rate of 83 percent. Respondents completed an average of seven of the eight interviews, resulting in a total of 7,221 daily interviews.

The National Study of Daily Experiences subsample and the National Survey of Midlife Development in the United States sample from which it was drawn had very similar distributions for age, marital status, and parenting status. The National Study of Daily Experiences sample had a slightly greater percentage of women (54.5% versus 51.5%), was better educated (60.8% of the National Survey of Midlife Development in the United States sample had at least 13 years of education versus 62.3% of the National Study of Daily Experiences subsample), and had a smaller percentage of minority respondents than the National Survey of Midlife Development in the United States sample. Of the National Study of Daily Experiences sample, 90.3 percent were white, 5.9 percent African American ,and 3.8 percent all other races (cf. a National Survey of Midlife Development in the United States sample that was 87.8% white, 6.8% African American, and 4.4% all other races). Respondents for the present analysis were on average 47 years old. 38 percent of the households reported having at least one child under 18 years old in the household. The average family income was between $50,000 and $55,000. Men were slightly older than women, had similar levels of education, and were more likely to be married at the time of the study (77% of the women versus 85% of the men were married).

Sampling weights correcting for selection probabilities and non-response allow the original National Survey of Midlife Development in the United States sample to match the composition of the U.S. population on age, sex, race, and education based upon the October 1995 Current Population Survey. A new sampling weight for the National Study of Daily Experiences sample was computed by dividing the unweighted National Study of Daily Experiences sample by the National Study of Daily Experiences sample weighted using the National Survey of Midlife Development in the United States sampling weight, and then multiplying this proportion by the original MIDUS sampling weight (i.e., unweighted N / weighted N * National Survey of Midlife Development in the United States S weight). Because the variables used in constructing the sample weights were controlled in all analyses and the pattern of results from analyses with and without the sampling weights were similar, unweighted results are presented (Winship and Radbill 1994).

Measures

Socioeconomic status was operationalized as a series of dichotomous indicators of educational attainment representing less than high school education (reference category); high school or some college; and college graduate. This strategy was chosen because it captures the well-established gradient of socioeconomic disadvantage (Adler et al. 1994; Marmot, Ryff, Bumpass, Shipley, and Marks 1997; Marmot et al. 1998), and it captures the primary educational benchmarks that provide the foundation for subsequent stratification processes by occupation and earnings (Marks and Shinberg 1998). Moreover, educational attainment has been the primary proxy for socioeconomic status used in previous studies, thereby allowing comparability with other studies; it is less prone to exhibiting missing data values; it is relatively stable across the life course after early adulthood; it is more comparable across men and women than occupation; and it is more comparable across single and married persons than income. Most importantly, education is less prone to endogeneity bias from reverse causality (e.g., health affecting the socioeconomic status measure) than measures such as income and occupation.

Daily psychological distress was operationalized using an inventory of ten emotions expanded from the psychological distress scale designed for the National Survey of Midlife Development survey (Mroczek and Kolarz 1998) and queried during each telephone interview. This scale was developed from the following well-known and valid instruments: The Affect Balance Scale (Bradburn 1969), the University of Michigan's Composite International Diagnostic Interview (Kessler et al. 1994), the Manifest Anxiety Scale (Taylor 1953), and the Center for Epidemiological

Studies Depression Scale (Radloff 1977). Respondents were asked how much of the time they felt: worthless; hopeless; nervous; restless or fidgety; that everything was an effort; and "so sad that nothing could cheer you up." Response categories for the index items were 1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time. Scores across the ten items were summed (α = .89).

Daily physical symptoms were measured using a shortened version of Larsen and Kasimatis's (1991) physical symptom checklist. Items that overlapped with the psychological distress scale (e.g., "urge to cry") were omitted. Our five-item scale assessed five constellations of symptoms: aches/pain (headaches, backaches, and muscle soreness), gastrointestinal symptoms (poor appetite, nausea/upset stomach, constipation/diarrhea), chest pain or dizziness (symptoms often associated with cardiovascular functioning), flu symptoms (upper respiratory symptoms, sore throat, runny nose, fever, chills) and a category for "other" physical symptoms or discomforts. Open-ended responses to the "other" physical symptoms question were subsequently coded and placed into an existing category, deleted if the symptom was psychological (e.g., felt anxious), or left in a miscellaneous category if no other category existed. Each day the respondents indicated how frequently they experienced each symptom over the past 24 hours on a five-point scale where 1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time. Scores across the five items were summed (α = .71).

Daily stressors were assessed with the Daily Inventory of Stressful Experiences (Almeida et al. 2002). The Daily Inventory of Stressful Experiences is a semi-structured instrument containing seven "stem" questions for identifying whether stressful events occurred in various life domains, as well as a series of questions for probing affirmative responses (see the Appendix for a detailed description of the "stem" questions and examples of "probes"). Almeida and colleagues' (2002) analyses highlight several descriptive features of Daily Inventory of Stressful Experiences measures that are highly relevant to the current study. First, respondents reported experiencing at least one stressor on 37.8 percent of the interview days, and multiple stressors were reported on 10 percent of interview days. Next, the most common form of daily stress for women and men was interpersonal stressors, followed by work stressors for men and network stressors for women. Finally, although subjective and objective appraisals of stressors are based on the same experience, the association between these measures was modest (r = .36). Thus, the Daily Inventory of Stressful Experiences produces estimates of daily stressors with ample variation, and objective and subjective characterizations of stressor severity appear to be relatively independent of each other.

For each daily interview, individuals who responded affirmatively to any of the stem questions received a value of 1 on an indicator variable of *any stress*; they were coded 0 otherwise. Respondents' narrative responses to investigator probes provided objective information on the content of the stressful experiences as well as the meaning of the stressor for the respondent. *Objective severity*, similar to Brown and Harris's (1978) ratings of short-term contextual threat, was assigned by trained coders based upon the degree of disruptiveness and unpleasantness associated with the stressor. Coders' scores ranged from a minor or trivial annoyance (coded 1) to a severely disruptive event (coded 4). Inter-rater reliability (kappa) on the objective severity measure was .75. *Subjective severity* reflects respondents' assessments of each stressful event on a four-point scale ranging from "not at all stressful" to "very stressful." Four mutually exclusive categorical variables reflecting stressor severity were then constructed by first dichotomizing each of the severity measures as high versus low (i.e., greater than or equal to one standard deviation above the sample mean coded as one); then categories were created reflecting low subjective/low objective severity, low subjective/high objective severity, high subjective/low objective severity, and high subjective/high objective severity. The cutoff of the mean plus one standard deviation was chosen because it is commonly used to represent "high" values (Aiken and West 1990; Jaccard, Turrisi, and Wan 1990) and it provided a more conservative measure of severe stressors than alternatives such as a mean split.

ANALYSES

The method used to examine the association

between physical symptoms, psychological distress, stressor exposure, and socioeconomic status within individuals over time was based on a multilevel model, also commonly referred to as a hierarchical linear model (Bryk and Raudenbush 1992). In this multilevel model, a lag-analysis was used, with prior day physical symptoms predicting current day physical symptoms, and prior psychological distress predicting the level of psychological distress reported on the current day. By controlling for prior-day values for physical symptoms and distress when predicting the current day values, the specification is equivalent to (but more flexible than) a change score model.

Stressor exposure was alternately defined as (1) whether the respondent experienced any stressor, and (2) whether the respondent experienced any stressors in the following severity categories: low subjective/low objective, low subjective/high objective, high subjective/low objective, high subjective/high objective. Respondents experiencing multiple stressors on the same day were categorically assigned based upon the average severity of all stressors. In both sets of analyses, persons experiencing no stressors were the comparison group.

The simple form of an hierarchical linear model can be conceived of as two separate models, one a within-person model (Level 1) and the other a between-person model (Level 2). A distinctive feature of hierarchical linear model is that the intercepts and slopes are allowed to vary across persons (Lee and Bryk 1989), allowing estimates of between-person models of within-person variability. To examine the temporal links between daily psychological distress and stressors, we fit a within-person model essentially equivalent to 1,031 regressions assessing daily covariation of stressors and distress. The unit of observation for each of these regressions is the person-day, so the sample size for each of these regressions is $N = 8$. Using a simple example in which health depends on a single explanatory variable—stressors—the model can be expressed as:

$$\text{Level 1: HEALTH}_{it} = a_{0i} +$$

$$a_{1i}\text{STRESSOR}_t + e_{it}, \quad (1)$$

where HEALTH_{it} is the reported health outcome (i.e., physical symptoms or psychological distress) of person i on day t, STRESSOR indicates whether person i experienced a stressor on day t, a_{0i} is the intercept indicating person i's average level of health when no stressor was reported, a_{1i} is the slope indicating the association between stressor exposure and health for person i, and e_{it} is the random component or error associated with distress of person i on day t . To estimate average effects for the entire sample, the intercepts and slopes of the Level 1 within-person model become the outcomes for the Level 2 between-person equations as follows.

$$\text{Level 2: } a_{0i} = B_0 + d_i, \quad (2)$$

$$a_{1i} = B_1 + g_i \quad (3)$$

The sample size for each of the Level 2 regressions is $N = 1,031$. Equation 2 shows that person i's average health score across the diary days (a_{0i}) is a function of the intercept for the entire sample (B_0)—the grand mean of the sample—and a random component or error (d_i). Likewise, equation 3 shows that person i's slope between distress and health (a_{1i}) is a function of the grand mean of the entire sample (B_1), and a random component or error (g_i). As discussed earlier in this paragraph, this basic model was extended to include prior day physical symptoms or negative affect as covariates for their respective outcomes to attenuate the possibility of reverse causality, whereby previous days poor health (physical or mental) contributed to both experiencing a stressor and health problems on any given day.

Hierarchical linear modeling provides the flexibility to allow the intercepts and slopes to vary across persons by stable individual characteristics (e.g., socioeconomic status). For example, to examine socioeconomic status differences in the daily covariation of distress and stressor exposure, one can formulate the following model:

$$\text{Level 1: DISTRESS}_{it} = a_{0i} +$$

$$a_{1i}\text{STRESSOR} + e_{it} \quad (4)$$

$$\text{Level 2: } a_{0i} = B_0 + B_1(\text{SES}) + d_i, \quad (5)$$

$$a_{1i} = B_2 + B_3(\text{SES}) + g_i \quad (6)$$

Equations 5 and 6 model socioeconomic status

differences in Level 1 intercepts and slopes. Of particular note is equation 6 because it considers the differential vulnerability hypothesis by testing whether the stressor-distress slopes (a_{1i}) vary according to socioeconomic status.

In these analyses, a model where the slope is constrained to be equal across subjects (for example, a model where the strength of the association between distress and stressor exposure is the same across all participants) is compared to one where the slopes are allowed to vary across individuals (in this example, a model where the association is not the same across individuals with differing socioeconomic status). The models are compared by taking the difference between the obtained model fits (i.e., –2 ln(likelihood)) and testing its significance with the degrees of freedom equal to the difference in the number of parameters of the two models (df = 2, in this example) (Bryk and Raudenbush 1992). If the models are not significantly different, the model constraining the slopes to be equal is chosen for reasons of parsimony.

RESULTS

Table 1 presents means and standard deviations for all variables of interest across education levels. There is a clear inverse gradient in daily physical symptoms and daily psychological distress such that college graduates reported better health than those with a high school degree or some college, and the latter group

was in turn in better health than those with less than a high school degree. More conservative analyses (i.e., $p \leq .01$), however, suggested no differences in physical symptoms or psychological distress between individuals with less than a high school degree and those with a high school degree or some college.

In terms of overall exposure to stressors, respondents with less than a high school degree reported experiencing stressors on 30 percent of the study days, while those with a high school degree and/or some college and those with a college degree reported experiencing stressors on 38 percent and 44 percent of the study days, respectively. Although better educated individuals reported stressors on a larger percentage of days, the stressors that were experienced were objectively less severe, on average, for college graduates and those with a high school degree than for those with less than a high school degree. College graduates experienced stressors that were also *subjectively* less severe than stressors experienced by individuals with less than a high school degree.

Hierarchical linear modeling estimates of the effects of education and stressors on daily physical symptoms and daily psychological distress are presented in Tables 2 and 3. Model 1 in each table is the baseline model, showing the effect of education on daily physical health and psychological distress adjusting for the effects of age, gender, race, and previous day's symptoms (physical or psychological, depending upon outcome). Because these models con-

TABLE 1. Means and Standard Deviations for Physical Symptoms, Psychological Distress, and Stressor Characteristics by Educational Attainment

	Less than High School (n = 78)	High School or Some College (n = 642)	College Graduate (n = 311)	F
Physical symptoms	2.39	1.77[a]	1.43[a,b]	9.87***
	(3.21)	(1.79)	(1.44)	
Psychological distress	3.51	1.91[a]	1.30[a,b]	21.19***
	(5.79)	(2.77)	(1.83)	
Frequency of stressors	0.30	0.38[a]	0.44[a,b]	9.40***
	(0.34)	(0.27)	(0.23)	
Severity of stressor				
Subjective[c]	2.91	2.76	2.64[a]	5.13**
	(0.89)	(0.69)	(0.58)	
Objective[c]	2.26	1.81[a]	1.75[a]	16.72***
	(0.90)	(0.69)	(0.56)	

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Note: Weighted estimates from the National Study of Daily Experiences.

[a] different ($p \leq .05$) from individuals with less than a high school degree.

[b] different from individuals with a high school degree or some college.

[c] values are based on reported stressors only.

TABLE 2. Hierarchical Linear Modeling Estimates and Standard Errors Predicting Daily Physical Symptoms

	Model 1	Model 2	Model 3	Model 4	Model 5
Less than High School (reference)	—	—	—	—	—
High School or Some College	−.36**	−.36**	−.35**	−.25	−.23
	(.14)	(.14)	(.13)	(.17)	(.15)
College Graduate	−.54***	−.57***	−.55***	−.44**	−.41**
	(.15)	(.14)	(.14)	(.15)	(.15)
Previous Physical Symptoms	.38***	.38***	.38***	.38***	.39***
	(.01)	(.01)	(.01)	(.01)	(.01)
Any Stressors		.35***		.75***	
		(.05)		(.19)	
Stressor Severity					
No Stressor (reference)			—		—
Low Subjective/Low Objective			.15		.75*
			(.08)		(.38)
Low Subjective/High Objective			.28**		−.10
			(.11)		(.45)
High Subjective/Low Objective			.46***		1.18***
			(.08)		(.35)
High Subjective/High Objective			.45***		.82***
			(.06)		(.24)
HS/College * Any stress				−.41	
				(.20)*	
College grad * Any Stress				−.44	
				(.21)*	
HS/College * Low Sub/Low Obj.					−.57
					(.39)
College Grad. * Low Sub/Low Obj.					−.72
					(.40)
HS/College * Low Sub/High Obj.					.19
					(.47)
College Grad. * Low Sub/High Obj.					.68
					(.48)
HS/College * High Sub/Low Obj.					−.78*
					(.36)
College Grad. * High Sub/Low Obj.					−.75*
					(.37)
HS/College * High Sub/High Obj.					−.36
					(.26)
College Grad * High Sub/High Obj.					−.45
					(.27)
Variance Explained	71.1%	72.5%	73.3%	72.9%	73.7%

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Note: Unweighted estimates from the National Study of Daily Experiences. Models adjust for the effects of age, gender, and race.

trol for symptoms on previous days, they should be interpreted as models of health *change* as opposed to models of *levels* of health. Additionally, it is important to recognize that this model specification will likely attenuate associations between education and health because part of the exogenous effect of socioeconomic status on current symptoms will be indirect, through the endogenous effect of prior symptoms.

The remaining models systematically assess different aspects of the differential exposure and vulnerability hypotheses. Model 2 in each table adds an indicator covariate assessing if any stressors were reported on the given day.

Model 3 for each of the outcomes adds dummy variables reflecting both objective and subjective stressor severity. Models 4 and 5 for each of the outcomes add interaction terms of these measures with education to assess vulnerability to stressors and stressor severity. (Note: sensitivity analyses using a household income covariate in addition to educational attainment yielded a pattern of results identical to those models without the income covariate. To streamline already complex models, results from the models without household income are reported below.)

Table 2 describes the analyses predicting within-person change in daily physical symp-

TABLE 3. Hierarchical Linear Modeling Estimates and Standard Errors Predicting Daily Negative Affect.

	Model 1	Model 2	Model 3	Model 4	Model 5
Less than High School (reference)	—	—	—	—	—
High School or Some College	–.97***	–.99**	–.93***	–.52**	–.47*
	(.20)	(.19)	(.19)	(.21)	(.20)
College Graduate	–1.15***	–1.24**	–1.15***	–.61***	–.57**
	(.21)	(.21)	(.20)	(.22)	(.21)
Previous Physical Symptoms	.32***	.31***	.32***	.31***	.31***
	(.01)	(.01)	(.01)	(.01)	(.01)
Any Stressors		1.01***		2.71***	
		(.07)		(.27)	
Stressor Severity					
No Stressor (reference)			—		—
Low Subjective/Low Objective			.20		–.12
			(.11)		(.54)
Low Subjective/High Objective			.26		.98
			(.15)		(.63)
High Subjective/Low Objective			1.08***		4.11***
			(.12)		(.49)
High Subjective/High Objective			1.72***		3.61***
			(.09)		(.34)
HS/College * Any stress				–1.66***	
				(.29)	
College grad * Any Stress				–2.06***	
				(.30)	
HS/College * Low Sub/Low Obj.					.41
					(.56)
College Grad. * Low Sub/Low Obj.					.20
					(.57)
HS/College * Low Sub/High Obj.					–.79
					(.66)
College Grad. * Low Sub/High Obj.					–.78
					(.68)
HS/College * High Sub/Low Obj.					–3.17***
					(.51)
College Grad. * High Sub/Low Obj.					–3.30***
					(.53)
HS/College * High Sub/High Obj.					–1.83***
					(.36)
College Grad * High Sub/High Obj.					–2.40***
					(.38)
Variance Explained	71.3%	74.2%	77.2%	74.8%	77.5%

* $p \le .05$; ** $p \le .01$; *** $p \le .001$
Note: Unweighted estimates from the National Study of Daily Experiences. Models adjust for the effects of age, gender, and race.

toms. Independent of the expected association between physical symptoms on the previous day and current symptoms, respondents with a high school degree and/or college degree were less likely to have an increase in physical symptoms than those without a high school degree (see model 1). Model 2 shows a positive association between daily stressors and current daily symptoms, indicating that on days when people reported any stressors, they also reported more physical symptoms compared to days when no stressors were reported. Exposure to any stressors did not mediate the education-symptom association, which is consistent with the evidence from Table 1 indicat-

ing that better-educated individuals reported stressors more, rather than less, frequently. Model 3 shows that individuals report more physical health symptoms when they experience stressors that are either objectively or subjectively severe, compared with experiencing no stressors. These results further suggest that subjective severity has a stronger association with physical health than does objective severity. Indeed, the magnitude of the estimate for stressors characterized as high subjective/high objective was comparable to those characterized as high subjective/low objective. Again however, the education-symptom relationship was not mediated by the inclusion of

different risk appraisals of stressors by education.

The final two models reported in Table 2 assess the mediating role of stressor vulnerability in the socioeconomic status-health association by examining between-person differences in the effects of stressor characteristics on physical symptoms. Model 4 suggests that experiencing a stressor is associated with an increase in average physical symptoms for all individuals; however, the increase is larger for those with less than a high school degree than for those with more education (.75, .34, and .31, respectively, for individuals with less than high school, high school and some college, and college graduates). Model 4 also suggests that part of the health differences between those with less than a high school degree and those with a high school degree and some college are explained by greater vulnerability to stressors by those with less education. Model 5 further suggests that individuals with some college and college graduates are particularly less vulnerable to stressors characterized by high subjective/low objective severity.

The first three models of Table 3 describe results from analyses predicting within-person changes in daily psychological distress from a differential exposure perspective. Model 1 demonstrates that education influences current day psychological distress independent of previous day distress as well as age, gender, and race. Model 2 shows that when a stressor is reported there is a greater average increase in distress in contrast to days when a stressor is not reported. A comparison of estimates from model 2 with those of model 1 shows that although the differences in magnitude are small and insignificant, the direction of change is consistent with the hypothesis that the greater exposure to daily stressors among college graduates (demonstrated in Table 1) suppresses educational differences in distress (i.e., the effect of being a college graduate gets larger after controlling for whether any stressors were experienced). This estimate is slightly reduced once the stressor severity is included in the model (see model 3), as one would expect, given that college graduates experience less severe stressors. Although experiencing stressors that are not subjectively severe does not appear to undermine mental health, stressors with high subjective severity are associated with increased negative affect, and this effect is accentuated when subjective appraisals correspond with objective appraisals. As with the physical health outcome, the overall pattern of results from the first three models of negative affect provide no evidence that differential exposure to daily stress explains educational differences in mental health.

The final models reported in Table 3 assess stressor vulnerability as a mediator of the education-distress association by considering if the slopes for the stressor characteristics vary by education. Model 4 suggests that nearly half of the educational differences in daily negative affect may be attributed to differential vulnerability whereby better-educated people are less reactive to any stressors in contrast to those with less than a high school degree. Estimates from model 6 further suggest that individuals with less than a high school degree are particularly more vulnerable to those stressors with a high level of subjective severity.

DISCUSSION

Four main patterns of results emerged from this micro-level examination of the interconnections between socioeconomic status, stress, and physical and mental health. First, higher status individuals, using education as proxy, reported better physical and mental health across the eight days of the interview, and they had more day-to-day improvements (or alternatively, smaller decrements) in physical symptoms and psychological distress than lower status individuals. Second, exposure to daily stressors was status-related, but higher-status individuals reported more, rather than fewer, stressful situations than lower-status individuals. However, of the stressors that were reported, lower-status individuals' stressors were more severe. Next, the results of this study provide strong evidence that daily stressors contribute to decrements in individuals' physical and mental health, particularly when the stressor is subjectively severe. Finally, in contrast to individuals with less education, better-educated individuals' physical and mental health were influenced less by daily stressors (i.e., they were less vulnerable). These results complement and extend previous research in several ways, and they compel new ways of thinking about and researching the stress process and its role in socioeconomic inequalities in health.

The descriptive epidemiology of daily stressors in this study extends the literature in several ways. First, most studies approach the context of socioeconomic disadvantage from a broad perspective by studying acute or chronic stressors; this is the first study using nationally representative data that examines daily stressors in the context of socioeconomic status. As Wheaton (1994) argues, daily stressors offer unique insight into the daily lives that are shaped by status hierarchies. Next, the investigator-based approach to measuring stress allowed consideration of both the incidence of stressors as well as the meaning of these stressors. Wethington and colleagues (1995) have argued that the distinction between a stressor event and its meaning may be pivotal to understanding the stress-health relationship. This contention was partially borne out in our analyses; that is, subjective appraisals of stressor severity were more strongly and consistently associated with physical and mental health than objective assessments of severity were. Finally, our results suggest that socioeconomic differentials in acute or chronic stressors do not manifest themselves in daily stressors.

The distribution of daily stressors in this study vis-à-vis previous studies of acute life events and chronic stressors raises several important issues for future empirical and theoretical development, because of its implications for evaluating exposure and vulnerability to daily stressors. In terms of exposure, given that nearly half of the variation in daily stressors can be attributed to previous acute or ongoing chronic stressors (Wheaton 1994), our results are compelling because they suggest the possibility of an intervening factor that mitigates the effects of chronic stressors on daily life. It is possible that cumulative socioeconomic disadvantage may desensitize lower status individuals to specific daily events that are reflective of hardship, and that these individuals' reports of daily stressors reflect independent, non-normative experiences. It is also possible, however, that the gendered nature of daily stressors (Almeida, Wethington, and Kessler 2002) as well as variation by gender or race in the types of chronic stressors produced by socioeconomic disadvantage (Krieger et al. 1997) may mask systematic variation in exposure to daily stressors: Our control variables for gender and race may not have adequately captured these complex associations. Of course, this pattern of findings could also be

an artifact of measurement and the possibility that respondents of lower socioeconomic status are less reflective and articulate than higher status respondents about all of the stressors they may experience in their lives. The fundamental issue is that comprehensive assessment of exposure to daily stressors requires consideration of the substantive and methodological factors affecting reports of daily stressors.

The unique and shared features of daily stressors and enduring conditions also have implications for stressor vulnerability. More specifically, enduring stressors may deplete physical or social resources for coping with new stressors, thereby making individuals more susceptible to the deleterious health effects of stressors, particularly severe stressors. The moderating effects of chronic stress such as overcrowding and poor neighborhood quality on the daily stressor-health association has been borne out in previous research (Caspi et al. 1987; Lepore et al. 1991); however, additional research applying the "double jeopardy" of chronic and daily stress to socioeconomic inequalities in health needs to be undertaken. Of course, the interplay of chronic and daily stressors also has implications for other explanations of differential vulnerability. For example, perhaps lower status individuals are more vulnerable to subjectively severe stressors because exposure to chronic stressors has depleted already disadvantaged social resources (Turner and Marino 1994) or exacerbate differences in personal resources such as mastery and self-esteem (Lachman and Weaver 1998; Turner et al. 1995; Wheaton 1983). Clearly, much more theoretical development and empirical work are needed to fully understand the cumulative toll of daily and other forms of stress.

Finally, the design and execution of this study provide strong evidence of the basic building blocks for implicating stress in socioeconomic disparities in health. Results of analyses examining within-person covariation of stress and health (i.e., Level 1 hierarchical linear model) clearly indicated that experiencing daily stressors, particularly those that are subjectively severe, promote declines in physical and mental health. In addition, results from the between-person analyses (i.e., Level 2 hierarchical linear model) strongly suggest that experiencing subjectively severe stressors promote negative changes in daily health more for those with less than a high school degree than

for those with a high school degree or college education. Although neither differential exposure nor differential vulnerability to daily stress completely explained socioeconomic differences in physical and mental health, it is clear that the stressor-health relationship cannot be considered independent of socioeconomic status.

Although this study provides an important and unique perspective of the interconnections among socioeconomic status, stress, and health, it is important to recognize its limitations. Perhaps the most significant limitation of this study is that data were only collected over an eight-day period and may not have adequately captured overall stress exposure. However, even though *individuals*' overall stress exposure may not have been fully measured, the overall design and execution of the National Study of Daily Experiences should have effectively captured the experiences of different socioeconomic *groups*. That is, the random assignment of start days for the daily interviews, the large sample and the correspondingly large number of interview days, and the "flight" methodology whereby individuals were interviewed throughout the year should minimize the possibility that the pattern of results of this study are an artifact of the relatively short duration of data collection. Next, although sample means and standard deviations are frequently used in research, our decision criteria for classifying stressors as "high severity" is relatively arbitrary, and the use of multiple categorical measures increases the possibility of Type I error because of multiple comparisons. Thus, interpretation should focus on the overall pattern of findings rather than individually significant effects. Finally, it is

worthwhile to restate that reporting biases by education in both symptoms and daily hassles may contribute to the overall pattern of results. On the other hand, potential reporting bias should be minimized by the statistical controls for prior-day symptoms.

Limitations notwithstanding, the results from this study extend previous research and emphasize the complexity of the interconnections among socioeconomic status, stress, and health, and they provide guidance for future theory development and research. The results of this study strongly suggest that daily stressors are linked to physical and mental morbidity, and that lower status individuals are more vulnerable to these stressors. The distribution of stressors in this study, in contrast to others, pushes future research to further explore the connections among acute, chronic, and daily stressors because socioeconomic differences in health likely reflect incremental and synergistic effects of different stressors across the stress universe. The results of this study also highlight the possibility that the meaning of stressors, in terms of severity, may be more important than stressors per se in explaining socioeconomic inequalities and health, and they lead to additional questions. For instance, which resources allow better educated individuals to better handle severe daily stressors? Similarly how can resources depleted by chronic stressors be rejuvenated to promote the capacity to cope with the stressors of daily life? Answers to these types of questions and a multidimensional, multilevel handling of stress are required for a comprehensive understanding of the role of stress in socioeconomic inequalities in health.

APPENDIX A.   Daily Inventory of Stressful Experiences

Stem Question	Examples of Probes for Description
Did you have an *argument or disagreement* with anyone since this time yesterday?	Think of the most stressful disagreement or argument you had since (this time/we spoke) yesterday. Who was that with?
Since (this time/we spoke) yesterday, did anything happen that you *could have argued* about but you decided to let pass in order to avoid a disagreement?	What happened and why did you decide not to get into an argument about it?
Since (this time/we spoke) yesterday, did anything happen at *work or school* (other than what you've already mentioned) that most people would consider stressful?	How does this affect your job?
Since (this time/we spoke) yesterday, did anything happen at *home* (other than what you've already mentioned) that most people would consider stressful?	Have you had any problems with this in the past?
Many people experience *discrimination* on the basis of such things as race, sex, or age. Did anything like this happen to you since (this time/we spoke) yesterday?	Think of the most stressful incident of this sort. What was the basis for the discrimination you experienced—your race, sex, age, or something else?
Since (this time/we spoke) yesterday, did anything happen to a *close friend or relative* (other than what you've already mentioned) that turned out to be stressful for you?	Think of the most stressful incident of this sort. Who did this happen to?
Did *anything else* happen to you since (this time/we spoke) yesterday that most people would consider stressful?	What happened and what about it would most people consider stressful?

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