

The Role of Psychological Characteristics in the Relation Between Socioeconomic Status and Perceived Health¹

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Separate analyses of United States and Finnish samples demonstrate a graded (almost linear) relation between socioeconomic status (SES) and risk of poor perceived health. In both studies, positive psychological factors (greater social support; less anger, depression, and perceived stress) and beneficial health practices (nonsmoking; drinking and exercising moderately) were associated with both higher levels of SES and better self-reported health. Psychological and health practice variables were both able to account for some of the SES and poor health gradient. However, contrary to expectations, these factors did not play a more important role in explaining decreased risk at the middle and highest levels of SES, and instead may be most important at lowest levels.

Persons low in socioeconomic status (SES) suffer from relatively poor health. This relation holds, irrespective of whether SES is measured as education, income, or occupation. Moreover, it is found for rates of mortality and morbidity from almost every disease condition (Antonovsky, 1967; Illsley & Baker, 1991; Kaplan, Haan, Syme, Minkler, & Winkleby, 1987; Syme & Berkman, 1976). Although many authors have focused on comparing individuals at the very bottom of the SES hierarchy to those who are better off, a number have emphasized that there is evidence for an association between increasing SES and increasing health at every level of the SES hierarchy, not just in comparisons with those below the threshold of poverty (e.g., Adler et al., 1994; Haan, Kaplan, & Syme, 1989; Marmot, Kogevinas, & Elston, 1987).

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There is substantial evidence for a graded relation with every increment in SES associated with an increment in health. Studies reporting evidence for graded relations between SES and prevalence of disease include a study where the frequency of 32 of 37 conditions increased with decreased educational attainment (Pincus, Callahan, & Burkhauser, 1987). A study of patients with rheumatoid arthritis similarly indicated that the lower a patient's educational level, the greater the chance of subsequent mortality or major decline in functional status (Pincus & Callahan, 1985). Other notable examples of the SES gradient are the association between rank in the British Civil Service and mortality (Marmot, Shipley, & Rose, 1984), a drop in occupational status and increased mortality (Susser, Watson, & Hopper, 1985), and decreased education (Kitagawa & Hauser, 1973; Pappas, Queen, Hadden, & Fisher, 1993) and income and increased mortality (Pappas et al., 1993). Further examples of this gradient are given in a number of reviews (e.g., Antonovsky, 1967; Haan et al., 1989; Kaplan et al., 1987; Marmot et al., 1987; Syme & Berkman, 1976). In many cases, the gradient is approximately linear (e.g., Marmot et al., 1987), although others find that those lowest in SES (especially income) have a somewhat accentuated risk (e.g., Pappas et al., 1993).

The graded nature of the SES and health relation presents a puzzle in regard to how SES influences health. Traditional explanations for the association of lower SES and poor health include poorer health care, greater environmental risk, poorer nutrition, and poorer health practices among lower SES groups. Although these provide plausible explanations of why persons lowest on the gradient suffer from poorer health, it is less clear why observed differences occur on the middle and highest parts of the gradient.

There are three categories of possible explanations for the graded association between SES and health (Adler et al., 1994; Black, Morris, Smith, & Townsend, 1982; Haan et al., 1989; Marmot et al., 1987): (a) genetically based differences exist between SES groups; (b) illness influences SES (drift hypothesis), rather than SES influencing illness; and (c) SES affects biological function that in turn influences health status. Adler et al. (1994) argue that although the first two explanations might contribute to the gradient, on the whole they are relatively implausible explanations. They instead focus on the third explanation. Their argument is that components of SES, including income, education, and occupation, shape one's life course and are enmeshed in key domains of life, including the physical and social environment, socialization and experiences that influence psychological development, and ongoing mood, cognition, and health practices (Anderson & Armstead, 1995). Recent evidence suggests that increasing SES is associated with more positive mood and cognition (Barefoot et al., 1991; House et al., 1992, 1994; Matthews, Kelsey, Meilahn, Kuller, & Wing, 1989; Ross & Wu, 1995) as well as with the performance of more beneficial health practices (e.g., Matthews et al., 1989; Ross & Wu, 1995). Increases in these psychological and behavioral characteristics with increases in SES may explain the graded

relation between SES and health (House et al., 1990, 1992; Ross & Wu, 1995; Williams, 1990), especially the decreased risk at the middle through highest levels of SES where there may be little health-relevant variation in the quality of physical environments or health care (Adler et al., 1994).

This article is an attempt to assess whether health practices and psychological characteristics can help us to understand part of the graded relation between SES and health. We present data from two large studies that include information on SES, self-reported health, psychological variables, and health practices. The two samples differ in age, gender composition, nationality, SES scaling, and range, and we present both to test the generality of the relations we address.

One data set derives from a survey of a probability sample of the United States conducted in 1983 to assess the role of stress in people's lives (Harris Poll). The other derives from the data collected between 1984 and 1989 in an epidemiologic study of Finnish men at risk for coronary heart disease (Kuopio Ischemic Heart Disease Risk Factor Study [KIHD]). In both cases, we establish the graded type relation between SES and health found in the work described earlier. We then attempt to assess the extent to which the relation may reflect patterns of health practices and psychological factors which differ between SES levels. The studies we report here were not primarily designed to examine the hypotheses we propose, and the psychometric quality of the measures is sometimes not optimal. In this context, it is a testimony to the robustness of the relations we find that there are clear associations and that they occur consistently across the two studies.

The outcome in both studies we report is self-reported physical health. Self-reported health reflects an individual's awareness of symptoms, diagnoses, and performance decrements and is a reasonable (but imperfect) marker of health status. More than a dozen long-term prospective studies have reported an association between self-reported poor health and mortality (e.g., Idler, 1992; Kaplan, Barell, & Lusky, 1988; Kaplan & Camacho, 1983). Although self-reports of health may reflect biases in interpreting physical sensations as well as underlying pathophysiology (Cohen & Williamson, 1991), the vast majority of variance in this measure has been found to be attributable to functional status, diagnosed physical illness, and medication use (Schulz et al., 1994). Keeping its limitations in mind, we treat self-reported health as a marker of subclinical and clinical morbidity and as a direct indicator of perceptions of health status.

Method

Participants

Harris Poll study. Respondents were 960 men and 1,427 women residents of the United States, 18 years of age and older (mean age = 42.8, *SD* = 17.2), who

completed a telephone interview conducted by Louis Harris and Associates, Inc. in 1983. No contact was made at 1,819 phone numbers. The 2,387 persons meeting the criteria for inclusion in the analyses represented 73.8% of the 3,235 eligible individuals with whom telephone contact was made (926 refused to be interviewed, and 117 terminated the interview prior to completion).

KIHD study. Of the 3,433 men, aged 42, 48, 54, and 60 years old, residing in the town of Kuopio, Finland, or its surrounding rural communities, 2,682 (82.9% of the 3,235 eligible men) agreed to participate in a 2-day examination. Of the non-participants, 198 were excluded because of death between listing on the population registry and baseline data collection, serious illness, or migration out of the area.

Sampling Techniques

Harris Poll study. Based on Bureau of Census information, a national area probability sample was developed from the distribution of the adult, noninstitutionalized population of the United States. Stratification was done according to geographic regions and by size of residential community. With counties as primary sampling units, a random-digit dialing procedure was used to select telephone numbers to be called within each sampling unit. To further ensure an unbiased sample, the interviewer asked to speak to the person in the household who was 18 years of age or over and whose birthday had been most recent. A total of 2,387 respondents was interviewed. The demographic profile of the sample population obtained through these procedures closely matched statistics from the 1980 U.S. Census.

KIHD study. The sampling frame for the KIHD study was based on a population registry which includes all Finnish citizens. Subjects were recruited in two waves. The first group ($n = 1,166$) was selected from all men aged 54 years of age in the area, with baseline data collection beginning March 1984 and ending June 1986. The second group consisted of a stratified random sample of one third of the men aged 42, 48, 54, and 60 years of age, with baseline data collection between August 1986 and December 1989.

Measures of SES and Demographics

Because the two samples derive from different cultures, the SES categories are not directly comparable. In the case of education, the educational systems are designed differently, and thus specific completion of a particular level is not comparable to the completion of the same level in the other system. For example, a high-school degree in Finland is probably equivalent to 1 or 2 years of college in the United States. In the case of income, converting Finnish currencies into dollars does not provide comparable categories in terms of actual spending power. As a consequence, we only compare specific income and educational categories

within countries. Cross-country comparisons focus on the nature of the entire distribution of SES categories in relation to specific variables (e.g., poor health).

Harris Poll study. An extensive interview included the determination of respondent's age, level of education completed, and household income. For education, respondents were asked the last grade or level of school completed. For analysis, we created four categories: eighth grade or less, some high school or high-school graduate, some college or college graduate, and postgraduate work. For income they were asked to indicate the category that best described their 1983 household income before taxes. For analysis, we created five categories (approximate quintiles): \$10,000 or less; \$10,001 to \$20,000; \$20,001 to \$30,000; \$30,001 to \$45,000; and \$45,001 or greater.

KIHD study. Participants provided extensive information including age, education, and household income. We report analyses using the highest level of education obtained grouped into four categories: some elementary school, finished elementary through some junior high, finished junior high or vocational, and senior high graduate or greater. The income measure reported here is the participant's annual income. For analysis, income (in Markka [mk]) is categorized into approximate quintiles: 0 to 37,000 mk; 37,001 to 59,999 mk; 60,000 to 77,999 mk; 78,000 to 106,000 mk; and 106,001 mk or more.

Measures of Psychological Variables

Both studies included measures of psychological stress, personal control, anger/hostility, depression, and social support.

Harris Poll study. Primary measures of stress included the 10-item Perceived Stress Scale (PSS-10; Cohen & Williamson, 1988), and a 16-item major stressful life events scale. The PSS-10 is a measure of the degree to which situations in one's life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The reliability (Cronbach's alpha) for the PSS-10 in this sample is .78. The life events scale consisted of 16 events representing potentially significant changes in the respondent's life. Respondents identified the events that had happened to them in the last year. The life event score is the total number of life events that the respondent indicated had happened.

For all of the remaining scales, subjects responded to items on a 5-point Likert scale ranging from 1 (*agree strongly*) to 5 (*disagree strongly*). The personal control scale was composed of a single item ("I feel I have little influence over the things that happen in my life."). Anger symptoms were based on six items. For each item, subjects were asked how likely they were to respond in a particular way when they get angry or annoyed. The six items included *feel weak, depressed, nervous or shaky, tense or worried, cry, or have a headache*. Cronbach's alpha was .70.

Social support was assessed by three items addressing the perception of support from others. The items included "I can always rely on my spouse or girlfriend (boyfriend) for emotional support," "I often feel lonely, like I don't have anyone to reach out to," and "My family and friends provide me with satisfaction and a sense of strength." The reliability of the scale was .53.

KIHD study. The stress measure was a 33-item major stressful life events scale. Life events were assessed by reports of their occurrence during the last 12 months. Because the responses were highly skewed (toward 0), respondents were grouped into approximate tertiles—0, 1, or 2 or more events. Personal control was assessed with a two-item hopelessness measure (presumably the opposite of feelings of control) scored on a 5-point Likert scale and added together (higher scores indicate less control). The score is strongly associated with risk of death from all causes and other outcomes (Everson et al., 1996).

Social support was assessed using the Quality of Social Relationship Scale (Kaplan et al., 1994). The eight items reflect the extent to which the respondent feels loved and close to others. The scale is significantly associated with risk of death (Kaplan et al., 1994). The scale's reliability in this sample was .83.

Anger was assessed by a short eight-item version of the Cook-Medley Hostility scale. The scale assesses cynical distrust and is thought to reflect the major toxic component of hostility. In this cohort, it is independently related to progression of carotid atherosclerosis (Julkunen, Salonen, Kaplan, Chesney, & Salonen, 1994). Cronbach's alpha was .80, and the 12-month test-retest correlation was .82.

Finally, depression was measured with a shortened, 59-item version of the Minnesota Multiphasic Personality Inventory Depression scale which has been used previously in Finnish populations. Raw scores were converted to *t* scores. Those in the top quartile are at significantly increased risk of death from cardiovascular causes in this sample (Everson et al., 1995). Cronbach's alpha was .71 and the 12-month test-retest correlation was .66.

Measures of Health Practices

Health practices assessed in both studies included smoking, alcohol consumption, and exercise.

Harris Poll study. Respondents were categorized as either current smokers or nonsmokers. Frequency (1 = *never* to 7 = *daily*) and quantity (1 = *1 drink* to 5 = *more than 5 drinks*) of alcoholic beverage consumption was also assessed. Drink rate was computed by multiplying the number of days a person drank by the number of beverages consumed on an average day they drank. This result is categorized as either 0 drinks per day, more than 0 but not more than 1 drink per day, more than 1 but not more than 2 drinks per day, and more than 2 drinks per day. Subjects rated how often they exercised strenuously for at least 20 min on a scale

ranging from 1 (*never*) to 7 (*daily*). The variable used in the analyses to represent exercise collapses across the original categories to create a scale with four categories: 3 days per month or less, 1 to 2 days per week, 3 to 4 days per week, and 5 to 7 days per week.

KIHD study. Respondents were categorized as either current smokers or non-smokers. Alcohol consumption was assessed by a self-administered questionnaire based on the Nordic Alcohol Consumption Inventory (Hauge & Irgens-Jensen, 1981). Frequency and amount of consumption of wine, beer (heavy and light), and spirits were reported separately. The analyses use the same breakdown of number of drinks per day as in the Harris Poll study.

Leisure-time physical activity was based on an extensive questionnaire (Lakka et al., 1994). The current analyses use a measure of the total duration of conditioning physical activity, which is significantly associated with risk of myocardial infarction in this population (Lakka et al., 1994).

Measures of Self-Reported Health

We used dichotomous measures of poor health instead of continuous scales. We did this for several reasons. First, the data available to us from the KIHD study were coded dichotomously and did not include the information required to create a continuous variable. Second, this type of analysis is characteristic of what has been used in studies predicting morbidity from self-reported health (Idler, 1992). Finally, these analyses produce effect size estimates (odds ratios) that allow easy comparisons between associations. Analyses of the Harris Poll data using continuous measures of health outcomes resulted in identical conclusions.

Harris Poll study. Respondents were asked to rate their current health status as *excellent*, *very good*, *good*, *fair*, or *poor*. Because we were primarily concerned with self-reported health as a marker of morbidity, the analyses we report predict the risk for fair or poor (14.6% of sample).

KIHD study. Respondents were asked to rate their current health status as *extremely good*, *good*, *average*, *bad*, or *extremely bad*. In the current analyses, we use bad and extremely bad grouped together (14.8%) as the outcome category.

Results

Analyses

We first present evidence that SES is related to poor health in a graded fashion, with increased SES associated with decreased risk of poor health. We then examine the roles of psychological variables and health practices as potential mediators of this relation. In order to provide evidence for a variable mediating

the relation between SES and poor health, we need to establish (a) that each potential mediator is associated with SES; (b) that each potential mediator is associated with poor health; and (c) that when controlling for the contribution of the proposed mediator, the relation between SES and health is substantially reduced (Baron & Kenny, 1986). We present analyses addressing each of these three requirements. Income and education are examined separately. Issues (a) and (b) are addressed with appropriate statistical analyses. However, because there is no statistical technique for comparing odds ratios (indicators of effect size in logistic regressions) across equations, we can only rely on the magnitude of change in these statistics as indicators of Issue (c)—the contribution of a proposed mediator to the relation.

The primary analytic technique we use is logistic regression with self-reported poor health as the outcome. The logistic regression analyses estimate the association between an independent variable and the relative odds of reporting poor health versus the other health categories. Thus, in the case of education, the relative odds of reporting poor versus other health is estimated for those at one education level compared to a reference level of education. In such an analysis, the odds ratio (OR) can be interpreted as an estimate of the relative risk of poor health for one level of education compared to the reference level. For example, an OR of 3 for the lowest education category indicates that there are three times as many persons reporting poor health in that category than in the referent (in this study always the highest SES) category.

In most analyses we report, the sample size is based on the maximum number of subjects with all of the variables used in an analysis (see p. 448 in the Method section). However, in the case of analyses relating SES to poor health, we compare ORs across analyses that include different sets of control variables. For the analyses to be comparable, they must use identical samples. As a result, all of these analyses (Figures 1 and 2) include only subjects with complete data on age and all of the psychological and health practice variables used in the final (with smallest n) analysis. For education, the sample sizes for these analyses are 2,276 for the Harris Poll study and 2,356 for the KIID study. For income, the sample sizes for these analyses are 2,105 for the Harris Poll study and 2,359 for the KIID study.

SES Indicators as Risk Factors for Poor Health

Logistic regressions were fitted to estimate the age-adjusted odds of reporting poor health for each education quartile in comparison to the highest quartile and each income quintile in relation to the highest quintile. The bar graphs on the far left side (age-adjusted only) in Figures 1A and 1B report these ratios for education and Figures 2A and 2B report these ratios for income. As is apparent from the figures, in both samples the odds of reporting poor health increase as both

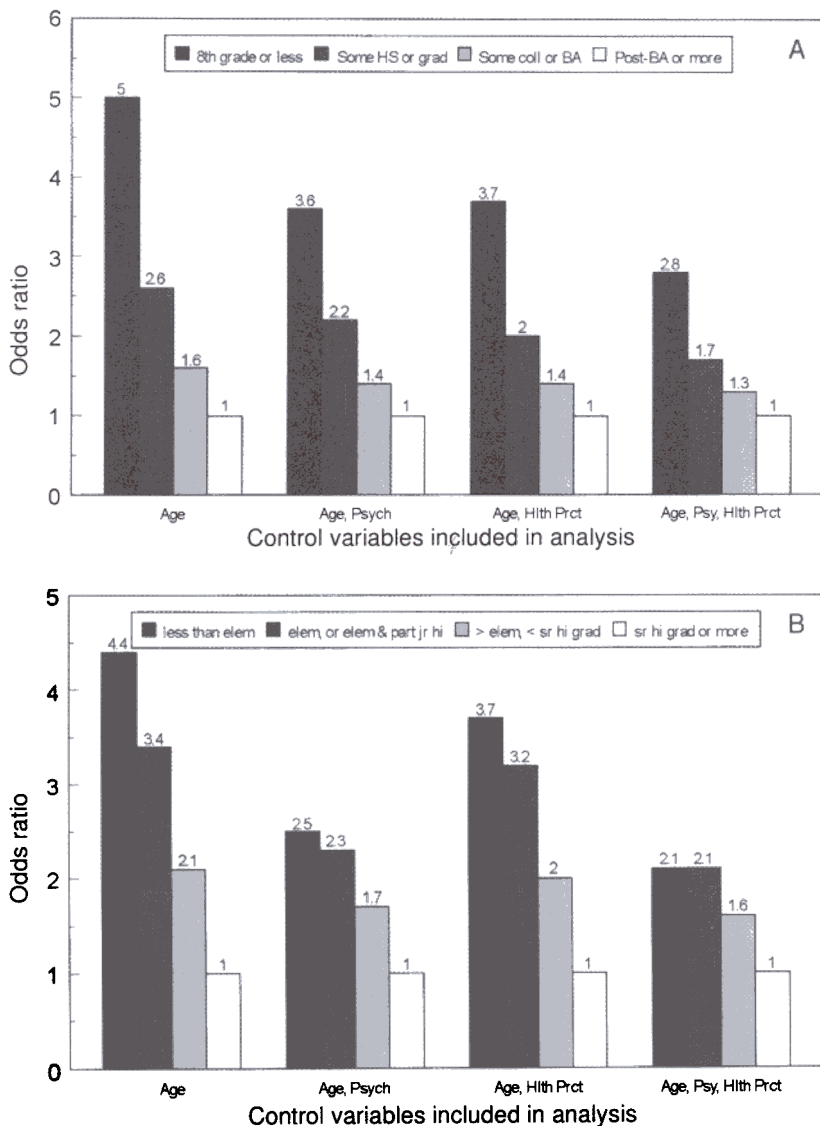


Figure 1. Age-adjusted odds ratios comparing each education category with the highest category in the prediction of self-reported poor health. Each set of bars represents odds ratios from logistic regressions including different sets of controls (covariates). Psych = psychological variables. Hlth Prct = health practice variables. Figure 1A is data from the Harris Poll study and Figure 1B is data from the KIHD study.

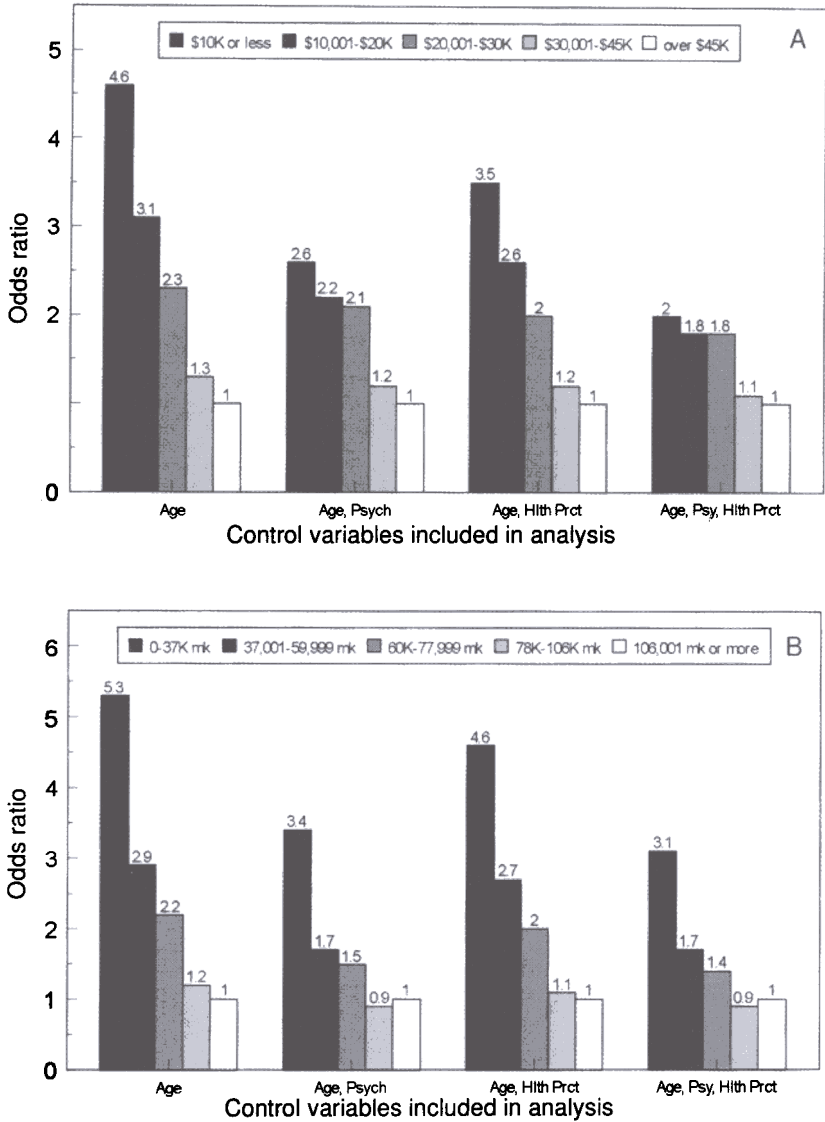


Figure 2. Age-adjusted odds ratios comparing each income quintile with the highest quintile in the prediction of self-reported poor health. Each set of bars represents odds ratios from logistic regressions including different sets of controls (covariates). Psych = psychological variables. Hlth Prct = health practice variables. Figure 2A is data from the Harris Poll study and Figure 2B is data from the KIID study.

education and income decrease. The Wald statistics testing for the significance of the overall contribution of education in explaining poor health were 37.52 ($df = 3$) for the Harris Poll study and 27.53 ($df = 3$) for the KIHD study ($p < .001$ in both cases). For income they were 46.08 ($df = 4$) for the Harris Poll study and 88.31 ($df = 4$) for the KIHD study ($p < .001$ in both cases).

SES Indicators and Psychological Variables

Table 1 presents mean or category percentage (when appropriate) psychological scores by income and by education separately for the two studies. Analyses reported later are logistic regressions when the psychological variable is dichotomized and multiple linear regressions when it is continuous. In all but one case, the analyses adjusting for age result in the same pattern of results as the unadjusted means and percentages presented in the table. We identify the discrepancy in this single case.

Harris Poll study. As is apparent from the table, increases in both education and income are associated with increased personal control [for education, $F(3, 2336) = 23.54, p < .001$; for income, $F(4, 2149) = 21.96, p < .001$] and with social support [for education, $F(3, 2352) = 9.63, p < .001$; for income, $F(4, 2158) = 24.48, p < .001$]. Increases in both SES indicators are associated with decreased perceived stress [for education, $F(3, 2350) = 8.73, p < .001$; for income, $F(4, 2159) = 28.17, p < .001$], and with anger symptoms [for education, $F(3, 2349) = 16.74, p < .001$; for income, $F(4, 2158) = 13.31, p < .001$]. Finally, the number of persons with two or more stressful life events decreased with income (Wald = 91.97, $df = 4, p < .001$) and with education (Wald = 8.54, $df = 3, p < .04$). Adjusted ORs of 1.9, 1.3, 1.3, and 1 suggest an association not clearly apparent in the unadjusted percentages in Table 1.

KIHD study. As is apparent from Table 1, hostility [for education, $F(3, 2280) = 30.03, p < .001$; for income, $F(4, 2251) = 18.03, p < .001$], depression [for education, $F(2, 2582) = 5.97, p < .001$; for income, $F(4, 2547) = 13.74, p < .001$], and hopelessness [for education, $F(3, 2420) = 57.81, p < .001$; for income, $F(4, 2422) = 63.31, p < .001$] show strong inverse associations with both income and education level. In contrast, social support increased with increasing income, $F(4, 2581) = 7.91, p < .001$; and education, $F(3, 2618) = 2.57, p < .054$. Stressful life events were not reliably associated with either income or education.

SES-Indicator and Health-Practice Variables

A separate age-adjusted logistic regression was run, predicting each of the health-practice variables. Table 2 presents raw means or percentages for each health-practice variable by the income and education quintiles. In all but one case, the unadjusted data in the table show the same pattern as indicated by the

Table

Means and Categorical Percentages for Psychosocial Measures by Income and Education Separately for the Two Studies

	Income quintile					Education category			
	(low)	2	3	4	5 (high)	(low)	2	3	4 (high)
Harris Poll data									
Percentage with 2 or more life events	62.0	53.0	44.0	39.0	40.0	46.0	47.0	50.0	42.0
Social support	11.5	12.3	12.7	12.9	13.0	12.0	12.2	12.7	12.9
Personal control	3.2	3.5	3.8	3.8	4.2	3.1	3.5	3.8	4.2
Perceived stress	15.1	13.4	12.4	11.8	11.4	13.6	13.3	12.7	11.8
Anger symptoms	10.1	9.7	9.2	9.3	8.9	10.0	9.8	9.3	8.8
KIHD study									
Percentage with 2 or more life events	28.0	27.0	28.0	28.0	26.0	26.0	26.0	29.0	28.0
Social support	6.9	7.1	7.2	7.2	7.2	7.0	7.1	7.2	7.1
Personal control (hopelessness)	3.6	3.3	2.8	2.3	1.7	3.6	3.1	2.2	1.7
Anger (hostility)	13.7	13.3	12.9	12.3	11.4	14.2	13.1	12.2	10.3
Depression	70.1	69.3	67.7	65.5	64.2	68.4	68.2	66.3	63.8

age-adjusted ORs that result from the logistic regressions. We note the single exception in our description of the results.

Harris Poll study. Relations between SES and smoking were irregular and inconsistent across education and income. The greatest smoking occurred among the two lowest and the highest income quintiles, with the lowest likelihood of smoking occurring in the fourth quintile (Wald = 12.3, $df = 4$, $p < .02$). Similarly, the lowest smoking rates were in the lowest and highest education quartiles. However, this is the single case where age-adjusted ORs display a different pattern, with those below the median in education more likely to smoke than those above the median (ORs = 1.5, 1.9, 1.3, 1; Wald = 29.0, $df = 3$, $p < .001$). Increases in both income and education were associated with a greater likelihood of exercising vigorously (Wald = 19.5, $df = 4$, $p < .001$; Wald = 17.6, $df = 3$, $p < .001$, respectively) and drinking alcohol (Wald = 62.3, $df = 4$, $p < .001$; Wald = 66.2, $df = 3$, $p < .001$, respectively).

KIHD study. Smoking decreased with increasing income and education (for income, Wald = 56.6, $df = 4$, $p < .001$; for education, Wald = 30.9, $df = 3$, $p < .001$). The percentage of persons who drink alcohol increased with SES (for income, Wald = 23.8, $df = 4$, $p < .001$; for education, Wald = 14.8, $df = 3$, $p < .002$). Duration of physical activity increased with education (Wald = 41.0, $df = 3$, $p < .001$), but was less regularly associated with income although there was a peak in highest income group (Wald = 25.9, $df = 4$, $p < .001$).

Psychological Variables as Risk Factors for Poor Health

A separate age-adjusted logistic regression was run for each of the psychological variables predicting risk of poor health. This provides the approximate age-adjusted relative risk for each psychological variable. In the following section, we present the Wald statistics that indicate whether each variable contributed to the explanation of poor health. Table 3 presents the ORs for each category of each psychological variable. This allows a closer examination of the nature of each relation. Continuous variables were categorized for these analyses (quartiles if the distribution allowed and tertiles if it did not) so that ORs could be calculated. Age is treated as a continuous variable in all analyses. ORs that were significantly different from the reference category are indicated by asterisks in the table.

Harris Poll data. Higher scores on the life events (Wald = 59.93, $df = 3$, $p < .001$), perceived stress (Wald = 71.31, $df = 3$, $p < .001$), and anger symptoms (Wald = 56.93, $df = 3$, $p < .001$) scales were all related to greater risk of poor health, while higher scores on social support (Wald = 39.81, $df = 3$, $p < .001$) and personal control (Wald = 24.40, $df = 2$, $p < .001$) were associated with less risk. Examination of the ORs comparing each level of the category to its reference level suggests the approximate linearity of all of these relations.

Table 2

Categorical Percentages for Health-Practice Measures by Income and Education

	Income quintile					Education category			
	(low)	2	3	4	5 (high)	(low)	2	3	4 (high)
Harris Poll data									
Percent of smokers	31	34	29	24	31	24	35	27	22
Percent who drink alcohol	36	51	53	59	71	23	46	60	64
Percent who exercise vigorously at least weekly	42	53	54	55	65	35	48	58	60
KIHD study									
Percent of smokers	41	30	29	27	20	40	31	25	24
Percent who drink alcohol	81	85	86	88	93	83	84	88	94
Percent who exercise above median number of hr/yr	50	49	44	49	59	43	46	56	62

Note. Median number of hr/yr exercise is 67.50.

KIHD study. Increases in life events (Wald = 9.68, $df = 2$, $p < .008$), depression (Wald = 140.30, $df = 3$, $p < .001$), hostility (Wald = 9.48, $df = 2$, $p < .01$), and hopelessness (Wald = 76.04, $df = 2$, $p < .001$) were all associated with increased risk of poor health. Increased social support was associated with decreased risk (Wald = 24.72, $df = 3$, $p < .001$). As is apparent from Table 3, these relations are also approximately linear.

Health Practices as Risk Factors for Poor Health

Table 4 presents the odds ratios for each category of health-practice variables.

Harris Poll study. As is apparent from the table, smokers were at higher risk of poor health than were nonsmokers (Wald = 12.16, $df = 1$, $p < .001$). Increases in drinking (Wald = 28.32, $df = 3$, $p < .001$) were associated with less risk of poor health, and the association was approximately linear. Increases in exercise were associated with better health except for those who exercise the most, whose health was equivalent to those with the least exercise (Wald = 18.76, $df = 3$, $p < .001$).

KIHD study. Consistent with the Harris Poll study, smoking was associated with an increased risk of poor health (Wald = 22.50, $df = 1$, $p < .001$), while exercise was associated with decreased risk except for those who exercise the most (Wald = 10.67, $df = 3$, $p < .014$). In contrast to the United States study, the KIHD data suggest a U-shaped relation between alcohol consumption and health, with moderate drinking associated with a lower risk of poor health, and abstinence and heavy drinking associated with a relative risk similar to nondrinkers (Wald = 19.64, $df = 3$, $p < .001$).

Independence of Psychological and Health-Practice Measures in Predicting Poor Health

Because we are interested in assessing the independent roles of both the psychological and the health-practice variables, we fit additional regression equations predicting poor health for each study in which we entered (along with age) either all of the psychological variables, all of the health-practice variables, or all of the psychological and health-practice variables. The first question addressed by these analyses was whether there is substantial overlap of the psychological variables. In the Harris Poll study, life events, perceived stress, personal control, social support, and anger symptoms all made independent contributions to explaining poor health ($p < .02$). In the KIHD study, all of the psychological variables except social support and hostility made independent contributions ($p < .01$). The second question was whether the individual health-practice variables made independent contributions. In both studies, the contributions of all three

Table 3

Odds Ratios for the Psychological Measures in the Prediction of Perceived Poor Health

Harris Poll data		KIHD study	
Number of life events*		Number of life events*	
reference: 0 events	1.0	reference: 0 events	.0
1 event	1.6*	1 event	.3*
2 events	1.4	2 events	.4
3 or more events	3.6*	3 or more events	.6*
Social support*		Social support*	
Qrt 1 (reference): ≤ 10.5	1.0	Qrt 1 (reference): ≤ 6.3	1.0
Qrt 2: > 10.5 and ≤ 12.0	0.8	Qrt 2: > 6.3 and ≤ 7.1	0.8
Qrt 3: > 12.0 and ≤ 14.0	0.5*	Qrt 3: > 7.1 and ≤ 7.9	0.6*
Qrt 4: > 14.0	0.4*	Qrt 4: > 7.9	0.5*
Personal control*		Hopelessness*	
Trt 1 (reference): 1-3	1.0	Trt 1 (reference): 0-1	1.0
Trt 2: 4	0.6*	Trt 2: 2-3	1.6*
Trt 3: 5	0.5*	Trt 3: 4-8	3.7*
Anger symptoms*		Hostility*	
Qrt 1 (reference): ≤ 7	1.0	Trt 1 (reference): 1-10	.0
Qrt 2: > 7 and ≤ 9	1.4	Trt 2: 11-14	
Qrt 3: > 9 and ≤ 11	1.9*	Trt 3: 15-24	.6*
Qrt 4: > 11	3.3*		
Perceived stress*		Depression*	
Qrt 1 (reference): ≤ 8	1.0	Qrt 1 (reference): ≤ 58	1.0
Qrt 2: > 8 and ≤ 12.5	1.2	Qrt 2: > 58 and ≤ 65	1.9*
Qrt 3: > 12.5 and ≤ 17	1.7*	Qrt 3: > 65 and ≤ 75	3.5*
Qrt 4: > 17	3.7*	Qrt 4: > 75 and ≤ 118	7.5*

Note. Asterisks by variable names indicate that the variable made a statistically significant ($p < .05$) contribution to the equation. Asterisks by specific levels of a variable indicate that the odds ratio for that level is significantly ($p < .05$) different from the referent (OR = 1) level. Qrt = quartile, Trt = tertile.

Table 4

Odds Ratios for the Health-Practice Measures in the Prediction of Perceived Poor Health

Harris Poll data		KIHD study	
Smoking status*		Smoking status*	
Reference: nonsmokers	1.0	Reference: nonsmokers	1.0
Smokers	1.6*	Smokers	1.7*
Alcohol consumption*		Alcohol consumption*	
Reference: nondrinkers	1.0	Reference: nondrinkers	1.0
1 or fewer drinks/day	0.6*	1 or fewer drinks/day	0.7*
Between 1 and 2 drinks/day	0.3*	Between 1 and 2 drinks/day	1.3
More than 2 drinks/day	0.4*	More than 2 drinks/day	1.3
Exercise*		Exercise*	
Reference: 3 days/mo or less	1.0	Reference: < 24 hrs/yr	1.0
1-2 days/week	0.6*	> 24 and < 68 hrs/yr	0.7*
3-4 days/week	0.4*	> 68 and < 150 hrs/yr	0.6*
5-7 days/week	0.9	> 150 hrs/yr	0.9

Note. Asterisks by variable names indicate that the variable made a statistically significant ($p < .05$) contribution to the equation. Asterisks by specific levels of a variable indicate that the odds ratio for that level is significantly ($p < .05$) different from the referent (OR = 1) level.

health-practice variables were independent of one another. Finally, we addressed the independence of psychological and health-practice variables. In the Harris Poll study, all of the psychological and health-practice measures made independent contributions to poor health. However, in the KIHD study there was overlap between psychological and health-practice measures, with exercise no longer contributing to the explanation of poor health when the psychological variables were in the equation. As implied by the earlier analysis, hostility and social support also failed to contribute under these conditions.

Psychological Variables and Health Practices as Mediators of the Relation Between SES and Poor Health

For the final test of mediation, we included as covariates all of the psychological variables and health practices. We used continuous data when the variable was measured continuously and was approximately normally distributed and

categorical data when the variable was measured categorically or was not normally distributed. Categorical data were entered as dummy variables in the equation. These included life events and all of the health-practice variables in both studies.

As noted earlier, there is no statistical method for comparing the differences between equations with and without control variables. However, changes in each specific level of the SES gradient as controls are added are represented by corresponding changes in ORs (effect sizes) as presented in Figures 1 and 2.

In order to determine whether psychological variables could account for some of the relation between SES markers and self-reported health, a set of logistic regressions were fitted with both age and the entire set of psychological variables entered into the equation with the SES marker. The second bar graphs in Figures 1 and 2 report the resulting ORs. As is apparent from the figures, there was attenuation of risk across the graded relation between SES and health in both studies and for both income and education. The greatest absolute attenuation of risk occurred in the lowest SES groups.

The third bar graphs in the figures present ORs when age and health practices are controlled. In the KIHD study, health practices did not contribute substantially to the gradient for either income or education. In the Harris Poll study, health practices did contribute to the gradient relating education to poor health. Again, the contribution occurred across the gradient, but the greatest absolute reduction occurred at the lowest levels of education.

Finally, the fourth set of bars in the figures present ORs when age, psychological variables, and health practices are all controlled. In the KIHD study, controlling for the combination of psychological and health-practice variables adds to the explanation of poor health provided by psychological variables alone in the case of education, but adds less in the case of income. In the Harris Poll study, the addition of health practices adds to the explanation of the gradient in both cases. Percentage reductions here are, for the most part, equivalent across the gradient.

Discussion

As in previous studies, both the Harris and KIHD data support a graded relation between SES and risk of poor health (e.g., Haan et al., 1989; Kaplan et al., 1987; Marmot et al., 1987). Each increment in SES is associated with a decrement in risk. The relation appears most linear in form in the case of education in the KIHD study. In the other cases, increases in education and income at the higher end of the gradient are associated with reduced improvements in health (cf. Kitagawa & Hauser, 1973; Pappas et al., 1993). Overall, it is striking how similar the associations are across two samples that differ in terms of age, gender, nationality, and SES scaling and range.

The major focus of this work was to examine whether differences across the SES gradient in psychological variables or health practices could account for the relation between SES and poor health. We first considered psychological variables. We found consistent evidence indicating that increases in both income and education were associated with increases in positive and decreases in negative psychological characteristics (cf. House et al., 1992, 1994; Ilfeld, 1978; Wills, McNamara, & Vaccaro, 1995). These associations are consistent with the hypothesis that differing psychological styles are produced as a function of the differences in experiences of persons at different levels of SES.

All of the psychological variables were also associated with poor perceived health. Again, these relations were all approximately monotonic and indicated increased risk with increases in negative psychological characteristics and decreases in risk with increases in positive characteristics. Such relations are consistent with a growing literature associating psychological variables and disease outcomes (see reviews in Cohen & Herbert, 1996; Friedman & Booth-Kewley, 1987).

Finally, when the psychological characteristics were covaried out of the relation between the SES markers and poor health, there was some attenuation of the graded relation. In both studies and with both SES markers, most of the absolute attenuation occurred in the lowest SES category (cf. House et al., 1994). However, decreased risk occurs in all of the categories across the gradient. These data provide support for the contention that these psychological markers may constitute a proximal pathway through which SES is associated with health. However, the data are not consistent with Adler et al.'s (1994) argument that psychological characteristics are most important in explaining the middle and higher ranges of the gradient. It is surprising that the psychological variables are of equal or greater importance in helping us to understand the source of risk in the lowest SES categories. There are many more compelling explanations for increased risk among low SES persons, including poorer health care, greater environmental risk, and poorer nutrition. It seems likely that the psychological characteristics covary with these other sources of risk and that the large proportion of risk accounted for in the lowest SES groups in this study reflects these covarying pathways as well as independent contributions of psychological characteristics to poor health.

We then considered health-practice variables. Although SES was generally associated with health practices in both studies, the forms of the relations were somewhat different. In the Harris Poll study, there were greater numbers of smokers in the lowest and highest income group and fewest in the middle groups. In contrast, for education there were more smokers in the two lowest than in the two highest quartiles (after age adjustment). Increases in both SES markers were associated with increased exercise and increased alcohol consumption. In the KIHD study, increases in both SES markers were associated with less smoking.

Lowest and highest SES categories consumed the most alcohol (for both income and education) and exercised the most (education only). The differences in these relations across studies is difficult to explain. As we discussed earlier, the SES markers are not readily comparable across cultures, and the highest and lowest groups (where most of the differences occur) may reflect differences in extremes in the two societies or differences in social norms regarding health practices. On the other hand, the Harris Poll data on income and smoking seem inconsistent and might be anomalous. However, there is quite a bit of inconsistency across published studies addressing the relation between SES and smoking (Wills et al., 1995).

Relations between health practices and perceived poor health were more consistent across the studies than were relations between health practices and SES. In both cases, smoking was associated with a higher prevalence and moderate exercise with a lower prevalence of perceived poor health. Although moderate drinkers were at relatively low risk in both studies, higher consumption was associated with decreasing risk in the Harris Poll data but with increasing risk in the KIID data. Differences in the results for alcohol (particularly the rise in risk among heavier drinkers in the KIID study) may reflect the greater consumption in the highest consumption group. Finally, we covaried health practices out of the relation between the SES markers and poor health. In general, this reduced the relation between the SES markers and poor health, although the effect was smaller than that of the psychological variables. The one exception was the relation between education and poor health in the Harris Poll study. In this case, the health practices had an effect equivalent to that of covarying the psychological factors. Again, the greatest absolute changes were in the low SES group. Our implicit hypotheses that increases in SES would be associated with increases in health-enhancing behaviors was not strongly supported in either study. Without such relations, health practices cannot provide strong explanatory variables for a graded type of relation between SES and poor health.

The final set of analyses examined the degree to which psychological characteristics and health practices overlapped in helping us to understand the pathways linking SES and poor health. In all cases, the combination of psychological and health-practice variables explained more than did either set alone. However, the reduction associated with the combination of the two sets of variables is generally not considerably greater than that which occurred when only age and the psychological variables were entered into the equation. This is to some extent attributable to the overlap of psychological and health-practice variables in their prediction of poor health (especially in the KIID study).

The work we report is subject to a number of disclaimers. The data are cross-sectional and hence causal interpretations are not possible. As noted in the introduction, it is possible that illness influences SES (drift hypothesis) or that these relations are attributable to genetically based differences between groups or to

some other spurious factor associated with both SES and health. The scales used in these studies are not always as psychometrically sound as one would desire, and better measurement would undoubtedly provide more explanatory power. Moreover, because poor health is self-reported, it may reflect biases in responding to bodily sensations as well to pathophysiological states. This problem, however, is attenuated by the fact that this measure has been a reliable predictor of mortality in prospective studies and is substantially correlated with functional status, diagnosed physical illness, and medication use (Schulz et al., 1994). However, even if one rejects self-reported health as a reasonable marker of health status, the results we report are striking in terms of the importance of individual representations of health in relation to psychological variables, health practices, and SES. Finally, there is the issue of whether correlations between perceived health and psychological measures are not merely a reflection of the overlap of these measures; for example, the possibility that they both are tapping neuroticism. Interestingly, our data are not especially susceptible to this alternative since the psychological variables are roughly linearly related to both SES markers and self-reported health, but their impact as mediators is not linear but rather occurs primarily at the lowest levels of SES. Moreover, all of the psychological variables made independent contributions to poor health, suggesting that they were not serving as markers of a single underlying characteristic.

We also feel that it is important to emphasize that the psychological characteristics and health practices we have conceptualized as mediators are proximal products of the kinds of experiences that vary across SES. It is these experiences that cause people to feel more or less stress, control, anger, or social support, or to smoke, drink, or exercise. As noted earlier, the mediators we test may, in part, reflect their covariation with these experiences as opposed to their roles as causal agents. However, within these limits in interpretation, the consistency of many of the results in this study across two countries is striking. It is clear that a graded relation between SES and poor health exists and that, at least in part, it can be understood in terms of differences across the gradient in psychological factors and health practices.

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