Socioeconomic Status, Smoking, and Health: A Test of Competing Theories of Cumulative Advantage*

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Although both low socioeconomic status and cigarette smoking increase health problems and mortality, their possible combined or interactive influence is less clear. On one hand, the health of low status groups may be harmed least by unhealthy behavior such as smoking because, given the substantial health risks produced by limited resources, they have less to lose from damaging lifestyles. On the other hand, the health of low status groups may be harmed most by smoking because lifestyle choices exacerbate the health problems created by deprived material conditions. Alternatively, the harm of low status and smoking may accumulate additively rather than multiplicatively. We test these arguments with data from the 1990 U.S. National Health Interview Survey, and with measures of morbidity and mortality. For ascribed statuses such as gender, race, and ethnicity, and for the outcome measure of mortality, the results favor the additive argument, whereas for achieved status and morbidity, the results support the vulnerability hypothesis—that smoking inflicts greater harm among disadvantaged groups.

The socioeconomic status differential in health and mortality has been well described and summarized in empirical studies and review articles (e.g., Adler et al. 1994; Kunst, Groenhof, and Mackenbach 1998; McDonough et al. 1999; Robert 1998; Rogers, Hummer, and Nam 2000; Ross and Wu 1995; Williams and Collins 1995). Perhaps more surprising than the existence of the differential is its persistent and likely even growing importance in the last decades (Pappas et al. 1993; Preston and Elo 1995; Wilkinson 1996)—a period when economic growth, medical advances, increasing expectations for longevity, and higher spending for government health programs might have been expected to bring about greater health equality. Epidemiologists, public health officials, and funding agencies have, as a result, become increasingly aware of the problem, and have devoted considerable resources and efforts to understand the underlying causes of the differential (Cooper 2002; Lantz et al. 2001; Link and Phelan 1995; National Institutes of Health 2002).

Attention to the underlying causes of socioeconomic status differentials in health has highlighted two mechanisms. First, even in affluent societies, socioeconomic status differences in health outcomes result from the financial resources necessary for good health care and safe living conditions. High socioeconomic status provides the knowledge about health risks, ways to avoid them, and the means to manage and treat health conditions. For example, high socioeconomic status reduces the risk of poor health and mortality through more secure neighborhoods; better housing; safer working environments; more job-related benefits, including gyms and exercise programs; lower stress; and greater access to health information and medical care (Adler et al. 1994; Link and Phelan 1995; Preston and Taubman 1994; Rogers et al. 2000; Williams 1990).

Second, socioeconomic status differences may result in part from unhealthy lifestyle choices, which have become increasingly concentrated among low socioeconomic status groups. Their health problems thus involve

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something other than the inability to purchase health-promoting goods; they involve the (sometimes expensive) purchase of harmful consumer products. High tobacco use among those with low education, occupational status, and income (Duncan, Jones, and Moon 1999; Escobedo and Peddicord 1996; Graham 1995; Lawlor et al. 2003; Pampel 2002; Rogers, Nam, and Hummer 1995; Ross 2000) serves as a prime example of the adoption of self-destructive habits by deprived groups. Other lifestyle choices involving poor diet, excess alcohol, and inactivity also likely contribute to socioeconomic status differences in health and longevity (Rogers et al. 2000).

The literature has established that both sets of factors—socioeconomic status or material position, and lifestyle choices such as cigarette smoking—have an independent influence on health (Alder et al. 1994; Ross and Wu 1995; Schrijvers et al. 1999). Low socioeconomic status directly affects health through lack of material resources, and indirectly influences health by contributing to harmful lifestyles such as smoking. Yet trying to assess the *independent* influence of the two sets of factors may be misguided if socioeconomic status and smoking *combine* to determine health: Examining the combined or interactive influences of resources and lifestyles may instead offer a more meaningful approach.

THE COMBINED INFLUENCE OF SOCIOECONOMIC STATUS AND SMOKING: COMPETING THEORIES

Plausible theoretical logics exist for the alternative specifications of the combined influence of resources and lifestyles. The logics differ over whether one positive characteristic facilitates or inhibits the benefits of another positive characteristic, or, equivalently, whether one negative characteristic worsens or moderates the harm of another negative characteristic. For health and mortality, these arguments take the following forms.

High Socioeconomic Status Worsens and Low Socioeconomic Status Limits the Harm of Smoking.

Perhaps high socioeconomic status groups are harmed most by unhealthy behavior because, given their greater potential for good health, they have the most to lose from damaging lifestyles. Blaxter (1990) argues that, with good social circumstances (such as among high socioeconomic status, non-manual workers), healthy lifestyles improve physical well-being. However, with bad social circumstances (such as among low socioeconomic status, manual workers), healthy lifestyles make little difference. Because, in the words of Blaxter (1990), "unhealthy behaviour does not reinforce disadvantage to the same extent as healthy behaviour increases advantage," (p. 233) avoidance of smoking benefits high socioeconomic status groups more than low socioeconomic status groups. These differences in the effects of smoking on health may stem from the greater exposure to other adverse circumstances among low socioeconomic status groups compared to high socioeconomic status groups (Marang-van de Mheen, Smith, and Hart 1999). If low socioeconomic status groups experience poorer health because of their limited resources, dangerous work, high stress levels, and economic vulnerability, then trying to extend life through avoiding or ending tobacco use will bring little benefit (Bosma, Schrijvers, and Mackenbach 1999). In contrast, with circumstances favorable to good health and a long life, high socioeconomic status groups can fully reap the benefits of healthy tobacco choices. This argument thus implies that changing lifestyles such as smoking without changing the underlying circumstances of disadvantaged groups brings few benefits (Link and Phelan 1995): The harm of low socioeconomic status for health persists even in the absence of smoking.

In modeling the determinants of cigarette smoking, economists using a rational choice perspective make much the same point as Blaxter. Adda and Lechene (2001) suggest that individuals with long potential life expectancy (i.e., in the absence of smoking) will experience greater harm and more loss of life from smoking than those with short life expectancy. Because low socioeconomic status persons have lower life expectancy even among non-smokers, they experience less harm from cigarettes than high socioeconomic status persons and therefore are more likely to smoke. In contrast, higher socioeconomic status persons have more incentive to invest in healthy behaviors because they live longer (and earn high wages while working) as a result of those

behaviors. This logic also implies an interaction between socioeconomic status and smoking in affecting actual length of life: High socioeconomic status persons enjoy greater longevity benefits from not smoking than low socioeconomic status persons. The economic arguments predict, much as Blaxter predicts, that healthy behaviors bring fewer survival benefits to low socioeconomic status persons than high socioeconomic status persons.

In support of these arguments, Blaxter's (1990) cross-sectional study of adults in Britain finds that smoking worsens health more among non-manual than manual workers. However, this result appears in charts that do not present appropriate tests of significance. Duncan, Jones, and Moon (1993) present ecological or neighborhood results that are similar to those of Blaxter: Community deprivation mutes the difference in health between smokers and non-smokers, whereas community resources magnify the difference. Several studies of confounding forces in the risks of smoking also indirectly support Blaxter's arguments. Sterling and Weinkam (1990) and Smith and Shipley (1991) assert that, because of the hazards faced by manual workers, cessation of their smoking would not bestow the same longevity benefits as cessation among non-manual workers.

To illustrate the predictions of these arguments, panel a of Figure 1 depicts relationships between smoking and health problems for high and low socioeconomic status groups. Consistent with the claim that high socioeconomic status groups gain greater benefits from healthy behavior than low socioeconomic status groups (referred to as the Blaxter hypothesis), the positive relationship in the figure is stronger for high socioeconomic status than for low socioeconomic status groups. Consequently, the health gap between high and low socioeconomic status groups appears largest among those who smoke least.

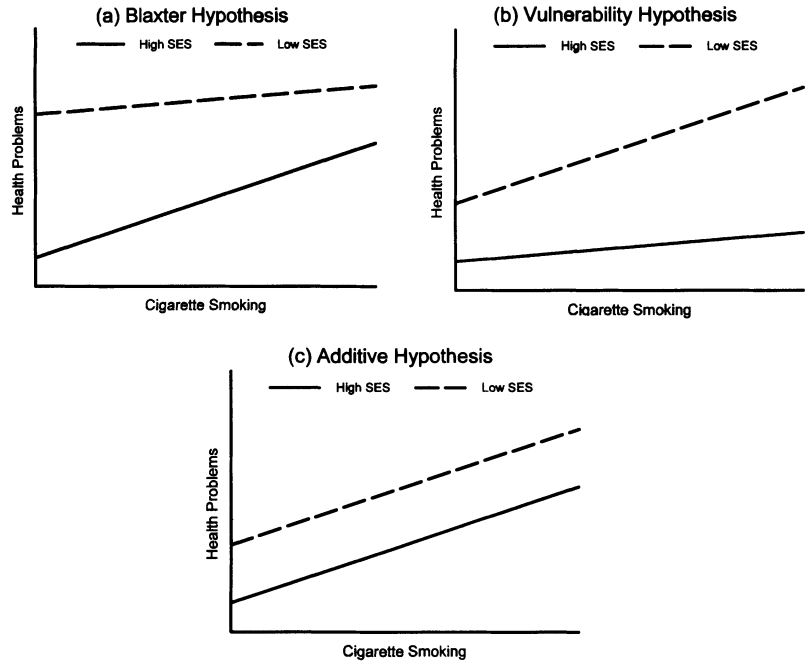
High Socioeconomic Status Limits and Low Socioeconomic Status Worsens the Harm of Smoking

Relying on an argument of social vulnerability, Birch, Jerrett, and Eyles (2000) suggest the opposite of Blaxter: Socioeconomic status inhibits rather than facilitates the harm and benefits of lifestyle choices, and behaviors such as smoking harm low socioeconomic status groups more than high socioeconomic status groups. Given their economic resources and favorable social circumstances, advantaged groups are able to overcome or buffer the harm of unhealthy lifestyles such as smoking. In contrast, less advantaged groups, because of their vulnerability to problems of all kinds, are more prone to suffer the adverse consequences of unhealthy lifestyles such as smoking. They experience multiple threats to their health, with each threat making the other more serious. The poorer diets, higher stress, more physically demanding jobs, and greater exposure to air pollution and carcinogens at work and home of those in deprived groups can, for example, make them particularly vulnerable to the harm of smoking for cancer, respiratory disease, and cardiovascular disease. Whereas lack of resources can exacerbate the health risks of smoking, positive lifestyles can do much to overcome the harm for health of poor social circumstances.

These claims also make sense in terms of ceiling effects in the returns to health-promoting behavior. Having already reached levels of health and longevity near the maximum for a particular time and place, high socioeconomic status groups have little room to improve. Healthy lifestyles such as abstaining from smoking therefore confer only limited benefits. Low socioeconomic status groups, in contrast, have more room for improvement, and the returns to healthy choices are likely to bestow greater benefits than they do for healthier, higher socioeconomic status groups. As they have the most to lose from smoking because of their heightened vulnerability, low socioeconomic status groups also have most to gain from not smoking because of their relatively low levels of health and short longevity.

This argument fits broader theories of social vulnerability (Ross and Wu 1995). Over the life course, members of high socioeconomic status groups develop greater resistence to disease because they enjoy better medical care, nutrition, and comfortable living conditions while growing up. These resources contribute over time to greater physiological resilience in dealing with the harm of lifestyles such as smoking. By contrast, because they have fewer resources for medical care, diet, and living conditions, members of lower socioeconomic status groups face more assaults on health over

FIGURE 1. Relationships between Cigarette Smoking and Health Problems by Socioeconomic Status (SES)



the life course that can decrease the body's resilience and ability to resist disease or, once ill, to recover from it. They are more likely to suffer from conditions such as high blood pressure, high cholesterol, and a weakened immune system because of cumulative assaults on the body. Similarly, diseases acquired early in life can profoundly affect later health, and lower socioeconomic status individuals are more likely to contract infectious diseases and suffer their adverse effects (Elo and Preston 1992). In many ways, then, the cumulative disadvantages of low socioeconomic status groups can make them more vulnerable to the harm of cigarette smoking and smoking-related diseases than high socioeconomic status groups.

Panel b of Figure 1 represents the vulnerability arguments by depicting a stronger positive relationship between smoking and health problems among low socioeconomic status than among high socioeconomic status groups. Because low socioeconomic status groups face greater harm from smoking than high socioeconomic status groups, the health gap between high and low socioeconomic status groups appears smallest among those who smoke least.

High Socioeconomic Status and Low Socioeconomic Status Do Not Modify the Harm of Smoking

Both of these sets of claims about the interaction of socioeconomic status and smoking may be incorrect. A more parsimonious argument would suggest that each factor contributes independently to health. Socioeconomic status may have similar effects across levels of healthy behavior, and healthy behavior may have similar effects across levels of socioeconomic status: Both socioeconomic status and smoking affect health, but the combination of both characteristics brings no special harm or benefit. Kooiker and Christiansen (1995) find evidence consistent with this argument in a study of persons ages 26–65 from Denmark and the Netherlands who have no chronic diseases and receive disability pensions. Similarly, Marang-van de Mheen et al. (1999) find in a prospective study of mortality in West Scotland that the effect of smoking differs only slightly between non-manual classes and manual classes, and the difference does not reach statistical significance. They conclude that smoking brings similar harm in all social circumstances.

Panel c of Figure 1 completes the compari-

son by depicting the additive relationships of socioeconomic status, smoking, and health problems. Whereas socioeconomic status reduces health problems and smoking increases health problems, they do so similarly across levels of the other variable, and the slopes do not differ for high and low socioeconomic status groups (although health problems are higher for low socioeconomic status groups).

Aims

To help evaluate these theories, understand how social advantages and disadvantages accumulate, and clarify how material conditions and lifestyles may combine in their influence on health, we examine the additive and interactive influence of socioeconomic status and cigarette smoking on morbidity, self-rated health, and mortality. The health damages of various lifestyles and the potential for interaction with socioeconomic status appear most clearly for cigarette smoking. Moreover, comparisons of the additive and interactive effects of smoking with those of other lifestyles such as inactivity, excess drinking, and overeating can help identify the nature and robustness of the combined influences of socioeconomic status and lifestyles.

METHODS

Data

To examine the effects of socioeconomic status on the relationship between cigarette smoking and health, we use the 1990 National Health Interview Survey. The survey includes annual information on a core set of questions (such as age, sex, race, ethnicity, marital status, income, education, employment status, and occupation) and also includes supplemental questions in particular years. We use the 1990 National Health Interview Survey Health Promotion and Disease Prevention supplement, which includes detailed information on cigarette smoking, along with other sociodemographic information and health status measures, for a sample of 41,104 non-institutionalized respondents aged 18 and above (National Center for Health Statistics 1993). The strengths of this data set are its nationally representative character, high response rates, large size, multiple measures of health behavior, and detailed information on health status.

For our analyses of the risk of death, we match the 1990 National Health Interview Survey Health Promotion and Disease Prevention supplement to the Multiple Cause of Death file through the National Death Index through 1997. The National Center for Health Statistics developed the recode linkage through a probabilistic matching scheme that assigns weights to each of the following factors: social security number; first and last name, middle initial; race; sex; marital status; day, month, and year of birth; and state of birth and residence (Horm 1996; National Center for Health Statistics 2000). In addition to the strengths listed above, this linked data set includes high quality matches between the National Health Interview Survey and Multiple Cause of Death file (Patterson and Bilgrade 1986), and thus allows additional insights into the risks of death. Matches to the Multiple Cause of Death file through December of 1997 yield 2,995 deaths over the eight-year follow-up period (National Center for Health Statistics 1993, 2000). After eliminating records ineligible to be linked to death certificate records, and cases with missing data on other variables of interest, we are left with 39,704 cases.

Measures

We use three outcome measures, all coded so that high scores represent health problems. First, morbidity takes the form of an additive scale based on four items: The number of existing activity limitations, restricted activity days in the last two weeks, bed disability days in the last year, and chronic conditions. All the items load on a single factor and, when combined into a scale, have an alpha reliability of .730. However, because about one-third of the sample scores zero on all the items, and only a small proportion of the sample has severe health problems, the scale is highly skewed. Taking the natural log of the scale helps normalize the distribution of the variable, but does not eliminate the censored observations. Second, self-rated current health has five values ranging from one (excellent) to five (poor); with poor health coded high, we refer to the measure as self-rated ill health. Third, the follow-up portion of the National Health

Interview Survey measures mortality in terms of the duration of months lived from the survey in 1990 through 1997. For the 8 percent of the sample that dies during the period, duration measures the months alive, and for the 92 percent of the sample that lives, duration measures the months until the censoring month of December 1997. Based on duration, the models examine the hazard of dying over the eight years. Unlike the other cross-sectional outcomes, the mortality outcome follows the survey.

The independent variables include measures of both ascribed, sociodemographic characteristics and achieved, socioeconomic status characteristics. We examine the additive and interactive effects of both types of variables, but refer to both sociodemographic and socioeconomic characteristics with the generic term of status. For the former, age measures decades from birth (with a maximum of 9.9 or 99 years old), and dummy variables code females as one, blacks as one, other non-whites as one, white Hispanics as one, and married persons as one. For achieved characteristics, education is measured as decades of completed schooling (with a maximum of 1.8 or 18 plus years),[1] and family income is measured in tens of thousands of dollars per equivalent person in the household.[2] Occupational status is measured for those with a job by Nam and Powers (1983) scores that in principle vary from 0 to 100; in this sample, we divide by 10 and the variable ranges from .15 to 9.98.[3] In combination with a dummy variable that codes those currently in the labor force as one and those out of the labor force as zero, the measure of occupational status times the dummy variable will show the effect of occupation only for those in the labor force.[4]

Cigarette smoking takes seven values: never smoked (1), former light smoker (2), former moderate smoker (3), former heavy smoker (4), current light smoker (5), current moderate smoker (6), and current heavy smoker (7). Light smokers use 1–14 cigarettes per day, moderate 15–24 cigarettes per day, and heavy 25+ cigarettes per day.[5] The ordering of the categories posits greater harm from current smoking than former smoking (Rogers and Power-Griner 1991) and assumes this ordering is continuous in nature. We experimented with several alternative measures, such as capturing the time since former smokers last smoked, but none worked better than the seven-point scale. We also found that treating cigarette use as a continuous variable works as well as a set of six dummy variables to represent the smoking categories. Note that, because nearly all smokers begin by young adulthood (U.S. Department of Health and Human Services 1994:4), current smoking reflects an enduring habit, and, except perhaps among some teens, precedes the existence of current health problems.

Estimation

We use tobit analysis to obtain estimates for the measure of morbidity. With one third of the sample having no activity restrictions, no bed disability days, and no chronic conditions, the morbidity variable is truncated and warrants the tobit analysis (Breen 1996). We use ordered logit analysis to obtain estimates of the effects of the determinants on self-rated ill health. The self-rated ill health variable is skewed toward lower values and positive health and might not define equal intervals, which makes ordered logit more appropriate than linear regression (Liao 1994). For mortality, we estimate Cox proportional hazard models (Allison 1984).

RESULTS

Background Models

Table 1 begins with a statistical summary of the measures. It lists the means, standard deviations, minimum, and maximum for the total sample, and the means for the subsamples of those who never smoked and who ever (formerly or currently) smoked. The mean differences between the smoking groups illustrate how the habit affects health and differs by ascribed, sociodemographic variables and achieved, socioeconomic variables. The means of the logged morbidity measure, self-rated ill health, and the dummy variable for death are all lower for the never smoked group than the ever smoked group (conversely, the mean duration lived is higher for the never smoked group). Relatedly, the measures of education, occupational status, and income are slightly higher for the never smoked group than the ever smoked group. Otherwise, the group means demonstrate that smoking appears more common among older persons than younger

TABLE 1. Descriptive Statistics, for Total Sample, Never Smokers, and Ever Smokers, NHIS 1990–1997

	Total Sample				Never Smoked	Ever Smoked	Correlation with Smoking
Variables	mean	s	min	max	mean	mean	r
Health Status							
Morbidity (logged)	.36	.38	0	1.67	.34	.39	.06
Self-Rated Ill Health	2.19	1.10	1	5.0	2.10	2.28	.09
Died (= 1)	.08	.28	0	1	.07	.10	.03
Duration (months)	85.80	14.04	1	95	86.50	85.10	–.03
Sociodemographic							
Age (decades)	4.52	1.83	1.8	9.9	4.43	4.61	–.04
Female (= 1)	.58	.49	0	1	.66	.50	–.14
Black (= 1)	.13	.34	0	1	.15	.12	–.04
Other Nonwhite (= 1)	.03	.17	0	1	.04	.02	–.03
Hispanic (= 1)	.07	.25	0	1	.08	.05	–.05
Married (= 1)	.54	.50	0	1	.52	.57	.01
Socioeconomic							
Education (decades)	1.26	.30	0	1.8	1.27	1.23	–.09
In Labor Force	.65	.48	0	1	.64	.65	.05
Occupational Status	5.35	2.60	.15	9.98	5.43	5.27	–.08
Family Income (10,000s)	2.46	1.99	.02	9.26	2.46	2.45	–.05
Smoking	2.72	2.08	1	7			

N = 39,704

persons, among men than women, and among married than unmarried persons. The correlations in the last column of Table 1 further describe the relationships between smoking and each of the other variables. Gender, education, and occupational status have the strongest negative correlations with smoking, while self-rated ill health, morbidity, and labor force participation have the strongest positive correlations. However, these statistics say little about how the effects of smoking on ill health and mortality differ by status.

Table 2 presents the additive models for all three outcome variables. These effects show the average influence of the status variables and smoking on logged morbidity, self-rated ill health, and the mortality hazard, and they provide a baseline from which to consider how the status variables and smoking combine to influence these health-related outcomes. A brief review of these well-known and often-demonstrated relationships in models 1–3 may prove helpful. Age increases morbidity and self-rated ill health, but with controls for socioeconomic status and smoking in models 2 and 3, the negative squared terms indicate that the effects tend to level off at the oldest ages; age also increases mortality but shows no systematic evidence of changes in the effects at older ages.[6] Consistent with much previous literature (Verbrugge and Wingard 1987), women have worse morbidity and self-rated health than men, but they have lower mortality risks. Note that the status variables explain a substantial part of the unadjusted gender differences in ill health, but not in mortality. Status variables also reduce the observed differences in morbidity, ill health, and mortality between blacks and whites. With controls for the status variables, blacks, other non-whites, and white Hispanics have lower morbidity, higher self-rated ill health, and similar hazards of mortality than other whites.

The additive models generally demonstrate the expected effects of the status variables.[7] Education and income consistently reduce morbidity, ill health, and mortality. Being in the labor force also reduces these negative outcomes, but occupational status has inconsistent effects: It increases morbidity, reduces self-rated ill health, and has little effect on mortality. These inconsistent results may be due in part to potential multicollinearity with the other socioeconomic status measures. Controls for smoking do not greatly change the effects of education, income, and occupational status on morbidity, self-rated ill health, and mortality.

Finally, smoking shows the expected positive effects on all three outcomes. Although Table 2 does not present the results, additional model estimates indicate that the effects of smoking on all outcomes change little with controls for other lifestyle variables such as drinking or inactivity, and that the effects of smoking on mortality change little with con-

TABLE 2. Unstandardized Coefficients and T-Ratios for Additive Models of Health Outcomes, NHIS 1990–1997

Independent Variables	Morbidity Logged Tobit Estimates			Self-Rated Ill Health Ordered Logit			Mortality Hazard Cox Estimates		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Age	.013	.096	.082	.259	.773	.675	.717	.725	.569
	2.28	15.67	13.03	8.92	24.24	20.81	9.60	9.88	7.63
Age^2	.003	−.007	−.006	.006	−.057	−.046	.008	−.005	.013
	5.28	−12.01	−9.27	2.05	−17.48	−13.89	1.27	−.81	2.19
Female	.053	.026	.033	.202	.059	.110	−.539	−.682	−.519
	14.12	6.78	8.56	10.76	3.03	5.58	−15.35	−18.37	−13.52
Black	.021	−.022	−.016	.709	.406	.449	.234	.051	.116
	3.91	−3.97	−2.89	25.89	14.27	15.68	4.65	.98	2.20
Other Nonwhite	−.070	−.084	−.078	.241	.160	.207	−.007	−.074	−.008
	−6.37	−7. 91	−7.30	4.49	2.92	3.78	−.05	−.56	−.06
Hispanic	−.033	−.066	−.057	.441	.018	.084	.065	−.078	.015
	−4.32	−8.65	−7.41	11.75	.45	2.14	.70	−.83	.16
Married		−.059	−.056		−.022	−.006		−.239	−.196
		−14.99	−14.40		−1.09	−.28		−6.16	−5.03
Education		−.070	−.060		−1.146	−1.077		−.214	−.174
		−9.62	−8.16		−30.14	−28.14		−3.83	−3.10
In Labor Force		−.181	−.183		−.400	−.417		−.472	−.496
		−27.43	−27.77		−11.89	−12.36		−5.45	−5.69
Occupational Status		.008	.009		−.023	−.020		−.013	−.005
		8.21	8.77		−4.63	−3.93		−.88	−.33
Family Income		−.016	−.015		−.131	−.128		−.083	−.075
		−14.60	−14.05		−22.77	−22.09		−6.28	−5.68
Smoking			.011			.077			.160
			12.07			16.62			16.76
Intercept	1.022	1.170	1.146						
cut 1				.800	−.690	−.524			
cut 2				2.102	.691	.864			
cut 3				3.662	2.345	2.523			
cut 4				5.116	3.857	4.037			
R^2	.062	.113	.117	.040	.072	.074	.090	.094	.098

N = 39,704

trols for self-rated ill health. As demonstrated extensively in previous studies (U.S. Department of Health and Human Services 1989, 2001), smoking has strong causal impacts on health and mortality.

Interactive Effects

Table 3 presents coefficients that test for the combined influence of the status variables (including both the ascribed, sociodemographic and achieved, socioeconomic variables, except for age and marital status, which serve as control variables) and smoking. For the total sample, and for males and females separately, the table lists the coefficients and t-ratios for the product terms of smoking by gender, race, ethnicity, education, labor force participation, occupation, and income for the health outcomes. Because the status variables overlap substantially, and including multiple interaction terms of status by smoking creates problems of multicollinearity, each interaction term is added individually to the additive model. Each coefficient thus comes from a separate equation that controls for the additive variables, but not for other interaction terms.

First, the results for the total sample (and separately for males and females) show few systematic differences in the effects of smoking on ill health and mortality across ascribed statuses. Of the coefficients for gender, race, and ethnicity, few reach statistical significance for a two-tailed test at the .01 level. Although some exceptions occur, the lack of a clear pattern of interactions suggests few differences in the effects of smoking across sex, race, and ethnicity, and the results for ascriptive characteristics favor the additive hypothesis rather than either of the interaction hypotheses.

Second, however, the results for the achieved status variables reveal something more: The harm of cigarette smoking for mor-

TABLE 3. Unstandardized Coefficients and T-Ratios for Interaction Terms of Smoking by Sociodemographic and Socioeconomic Status Variables in Determining Health Outcomes, Males and Females, NHIS 1990–1997

Interaction Terms	Morbidity Logged Tobit Estimates			Self-Rated Ill Health Ordered Logit			Mortality Hazard Cox Estimates		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Smoking x									
Female	.001	—	—	–.017	—	—	.023	—	—
	.36	—	—	–1.90	—	—	1.28	—	—
Black	.007	.007	.009	–.032	–.044	–.007	–.033	–.039	–.047
	2.54	1.64	2.50	–2.34	–1.99	–.37	–1.28	–1.04	–1.21
Other Nonwhite	.005	–.008	.023	–.054	–.054	–.049	–.002	.108	–.005
	.86	–1.11	2.69	–1.95	–1.38	–1.16	–.03	.95	–.06
Hispanic	.000	–.003	.006	–.021	–.059	.041	–.049	–.014	–.065
	.00	–.56	1.06	–1.04	–2.03	1.41	–1.03	–.21	–.87
Education	–.014	–.011	–.016	–.058	–.031	–.105	.045	.031	.074
	–4.60	–2.53	–3.43	–3.53	–1.32	–4.31	1.78	.87	1.87
In Labor Force	–.020	–.029	–.011	–.080	–1.03	–.063	.011	.032	–.017
	–10.72	–9.27	–4.53	–8.23	–6.00	–5.00	.56	1.20	–.54
Occupational	–.003	–.003	–.002	–.009	–.008	–.010	.000	.003	–.004
Status	–9.74	–6.69	–4.98	–6.63	–3.72	–5.24	.01	.70	–.63
Family Income	–.003	–.003	–.003	–.009	–.008	–.011	.001	–.002	.009
	–6.92	–5.31	–3.88	–3.66	–2.41	–3.25	.23	–.29	1.07

Total N = 39,704, Male N = 16,523; Female N = 23,181

bidity and self-rated ill health declines with higher education, labor force participation, occupation, and income.[8] Although the interactions do not reach significance for mortality, the consistently significant results for morbidity and self-rated ill health suggest that smoking has different health effects across status groups. The negative interaction coefficients mean that the harm of smoking for health, as predicted by the vulnerability hypothesis, becomes smaller at higher levels of education, labor force participation, occupational prestige, and income.[9]

Including all the status variable interactions together and removing overlap among education, occupation, and income eliminates some of the combined influences of smoking, but this also provides more information on the nature of the interaction. In general, labor force participation and income continue to interact most clearly with smoking, while education and occupational status no longer interact with smoking when including controls for the labor force participation and income interactions (results not presented). Although it is difficult to unravel the particular contribution of each of the overlapping status variables, the results demonstrate that at least some components of status work to mitigate the harm of smoking for health. Again for mortality, smoking shows no interaction with any of the status variables, either with or without controls for the other interactions.

Last, these results largely hold within groups of young and old. Other analyses (results not presented) examine separate models for three age groups (18–44, 45–64, 65+). The interactions for the oldest age group often appear weaker than for the young and middle age groups, but they generally affirm the existence and direction of the status and smoking interactions. Status thus does less to change the harm of smoking at the oldest ages, when the risks of poor health are higher.

Other Lifestyle Variables

These results also hold with controls for additional, overlapping lifestyle variables. The National Health Interview Survey data contain measures of physical exercise, stress, body mass, and alcohol consumption. The exercise measure consists of an additive index of current physical activity, the number of years of exercise, and activity compared to others; a high score indicates inactivity. The stress measure consists of an additive index based on stress experienced in the last two weeks (on a five-point scale), stress experienced in the last year (on a five-point scale), and the effects of stress on health (on a three-point scale). The drinking measure is based on the number of

days in the last two weeks that the respondent consumed alcohol. Finally, the body mass index measures being overweight by converting weight and height into metric units, and then dividing weight by height squared.

Although certainly relevant to physical health, these variables may result from, as much as cause, poor health. Those experiencing recent health problems may subsequently face more stress, begin drinking more, end efforts to exercise, and increase their weight. Models using these variables as determinants will overstate their effects. Even if overstated, however, these variables may provide a check—albeit an excessively stringent one—on the effects of smoking.

The first rows of Table 4 present the interactions of smoking with education, occupational status, and income on the three health outcomes when controlling for the interactions of the measures of exercise, stress, drinking, and body mass index with education, occupational status, and income. Drinking and the body mass index have curvilinear relationships with the health outcomes, and Table 4 includes interactions with both unsquared and squared terms. Comparing the results for the smoking and status interactions in Table 4 with those in Table 3 demonstrates that the interactions appear much the same with these controls as without. Higher status reduces the harm of smoking for morbidity and self-rated ill health, even when controlling for other lifestyle influences.

Furthermore, the use of these other lifestyle variables suggests another test of the robustness of the interaction results. If higher status reduces the harm of smoking for morbidity and self-rated ill health, and if this reflects more general processes, higher status should reduce the harm of measures of excess weight, inactivity, excess drinking, and stress levels for self-rated ill health. Examining Table 4 indeed shows that the direction of the interaction relationships involving the other lifestyle variables proves consistent with that for smoking.

TABLE 4. Unstandardized Coefficients and T-Ratios for Interaction Terms of Smoking by Socioeconomic Status Variables, Controlling for Other Lifestyle Interactions, NHIS 1990–1997

	Morbidity Logged Tobit Estimates		Self-Rate Ill Health Ordered Logit		Mortality Hazard Cox Estimates	
	b	t	b	t	b	t
Smokes						
* Education	–.015	–3.59	–.063	–3.76	.047	1.83
* Occupational Status	–.003	–8.81	–.010	–7.18	.000	.13
* Family Income	–.004	–5.89	–.009	–3.89	.002	.45
Inactivity						
* Education	–.066	–11.72	–.132	–4.09	–.013	–.28
* Occupational Status	–.007	–13.67	–.019	–6.51	–.024	–3.61
* Family Income	–.008	–10.02	–.026	–5.60	–.010	–1.02
Stress						
* Education	–.021	–3.69	–.100	–3.17	.003	.06
* Occupational Status	–.006	–11.58	–.021	–6.81	–.008	–1.12
* Family Income	–.007	–7.47	–.016	–3.00	.035	3.14
Drinking (x .01)						
* Education	.161	5.40	.351	2.09	–.165	–.52
* Occupational Status	.014	5.67	.061	4.29	–.022	–.60
* Family Income	.024	6.06	.058	2.62	–.021	–.39
Drinking^2						
* Education	–.053	–4.43	–.101	–1.51	.095	.78
* Occupational Status	–.005	–5.26	–.023	–4.03	.011	.83
* Family Income	–.009	–5.72	–.021	–2.41	.014	.65
Body Mass Index (x 100)						
* Education	–.039	–.80	.310	1.12	–.405	–.90
* Occupational Status	.003	.74	.036	1.28	.096	2.35
* Family Income	.013	1.36	.097	1.81	.183	2.15
Body Mass Index^2						
* Education	.001	.16	–.020	–.60	.040	.72
* Occupational Status	–.001	–2.36	–.004	–1.18	–.013	–2.82
* Family Income	–.002	–2.02	–.011	–1.55	–.026	–2.48

Consider first how inactivity and stress interact with status. For morbidity and self-rated ill health, both of these lifestyle variables have negative interaction coefficients with all three status measures. As with smoking, higher status mitigates the harm of lack of exercise and high stress. However, the interactions generally do not hold for mortality, again much the same as with smoking. The interaction results are more complex for body mass and drinking because these two variables have curvilinear relationships with health: Middle levels are associated with reductions in health problems, and both low and high levels are associated with increases in health problems. For the purposes of testing the hypotheses, the key coefficients involve the interaction of the status variables with the squared terms. They show how the status variables modify the harm of excess drinking and high levels of excess weight. Noting that the interaction coefficients for education, occupation, and income times drinking squared are negative for morbidity and self-rated ill health (but insignificant for mortality), the results once more affirm the direction of the interactions for smoking. As status increases, the contribution of excess drinking to morbidity and self-rated ill health decreases. However, the results for the body mass index measure of excess weight reveal little interaction. Despite these exceptions, the results generally support arguments that high status buffers and low status exacerbates the harm of unhealthy lifestyles.

CONCLUSION

In a study of health and lifestyles, Blaxter (1990) reported survey results for a national sample of British respondents that revealed less harm from smoking among low status groups than high status groups. However, other studies, based largely on more specialized samples, have not found support for this claim. This leaves the field with contrasting arguments about how, in particular, the harm of low status and cigarette smoking accumulate, and how, more generally, the harm of lack of resources and unhealthy lifestyles accumulate. In testing these arguments, we improve on previous studies by using high quality data for a national sample of U.S. residents in 1990 that includes follow-up mortality measures from 1990–1997, and by systematically testing for statistical interaction of smoking with measures of both ascribed and achieved status. For ascribed statuses of gender, race, and ethnicity, the results for all outcome health measures favor the additive argument. For achieved status, the results for self-rated ill health and morbidity favor the argument that smoking has greater harm for health among deprived groups, but the results for mortality favor the additive argument. These findings hold not only for smoking, but also for other lifestyle factors such as inactivity, stress, being overweight, and drinking to excess. Overall, then, the results support a social vulnerability argument (Birch et al. 2000; Ross and Wu 1995), and no evidence emerges in favor of Blaxter's arguments.

In addition to providing a specific test involving status and smoking, these results say something more generally about the nature of cumulative advantage and disadvantage. When resources and lifestyles combine to influence health, they do so in ways such that one disadvantage increases the harm of another disadvantage. For some health outcomes, then, a form of multiple jeopardy or synergism operates across disadvantaged positions in society. Rather than the harm for health of disadvantaged statuses canceling out, the harm is exacerbated. Thus, low socioeconomic status individuals may have to contend with more assaults on their health, some external and some self-imposed, that can reduce the body's resistance to and recovery from disease. Relative to high socioeconomic status groups, low socioeconomic status groups have relatively more to gain from not smoking. Limited resources and unhealthy lifestyles may not always combine in ways to make health worse: Indeed, resources and lifestyles often have additive influences. Still, when they do have a combined influence, resources and lifestyles worsen the health of disadvantaged groups.

Although the results are based on a national sample and multiple measures of status, lifestyles, and health outcomes, they may be limited in terms of their generality to other nations and time periods. The high level of inequality in the United States relative to most European nations may produce different findings than those from studies of other nations. The patterns found here may also be influenced by the context of the 1990s and may differ for other historical periods. The results could also be improved were longitudinal data

available for outcomes other than mortality. Continued study of different national and historical contexts, especially with longitudinal data, can contribute to our further understanding of the nature of cumulative advantage in resources and lifestyles.

Researchers and policy makers should endeavor to simultaneously improve health behaviors and socioeconomic status. Moreover, health policies should strive to satisfy the Pareto criterion: To benefit at least some people while harming none (Deaton 2002; LeGrand 1991). Although we should aim to reduce health disparities, we should at the same time avoid exclusively targeting the poor if interventions and public health programs such as anti-smoking campaigns could improve health for all socioeconomic status groups, and we should encourage and support new medical technologies and interventions even if they initially disproportionately benefit higher socioeconomic status individuals (see LeGrand 1991). Thus, social policies become all the more difficult because of the interactions between socioeconomic status and health, and because one public health goal may compete with another.

We must remain cautious about translating findings at the population level to policy recommendations at the individual level. Our results have identified the additional risk imparted by cigarette smoking and lower socioeconomic status at the population level. But intervention at the individual level may be unsuccessful because individuals may have low motivation to change their behaviors; may resist change; may realize no gains over the short term; are not guaranteed change over the long term; may face peer resistance; and may face some small risk through their changes. For example smoking cessation contributes to irritable mood, increased stress, weight gain, and cravings to resume smoking. Moreover, intervention at the individual level risks the Prevention Paradox: Preventive measures including lifestyle changes that result in great benefit to the population may contribute little to each individual (Rose 1985).

There are structural impediments that could thwart higher socioeconomic status attainment or improved health behaviors. Despite the potential for change, there is a sad irony that low socioeconomic status groups that are most vulnerable to poor health may exacerbate their poor health by engaging in multiple risky behaviors, including purchasing expensive and harmful consumer products such as tobacco, and that, once ill, they have fewer resources to combat their poorer health or to ease their discomfort. Unfortunately, compared to those with more resources, disadvantaged groups are more likely to initiate smoking, less likely to seek out and follow antismoking advice, and, consequently, less likely to quit. Lower socioeconomic groups—because of residential location, transportation limitations, or limited access—are unable to fully take advantage of smoking cessation programs. Furthermore, low income groups confront more immediate concerns than quitting smoking and may smoke as a way to cope with stressful living conditions (Lawlor et al. 2003). Thus, we must be careful when establishing policies and future research agendas to avoid blaming the victims.

In practical terms, the greater harm of unhealthy lifestyles for low status groups suggests that they can benefit substantially from improved lifestyles, and that progress can be made toward reducing health inequalities through changing behaviors—even in the absence of socioeconomic change. The evidence here suggests that low status groups have the most to gain from reduced smoking and other lifestyle improvements. Subpopulations can also increase their health and reduce their risk of death through increased levels of education, job promotion, and salary increases. Moreover, it may be that increases in socioeconomic status may help smokers find the resources, social support, and peer pressure to quit smoking. As the United States undertakes its Health People 2010 campaign, policy makers should be aware of both the potential interaction between socioeconomic status and smoking and the multiple interacting mechanisms that lead to better health.

NOTES

1. The measure will understate the ultimate educational attainment of respondents still enrolled in school. To the extent that additional schooling brings resources to improve health, this problem will not bias the results, but to the extent that completed schooling reflects stable underlying factors

that promote health, it can understate the effects of years of schooling.

2. Family income comes from two variables, one based on 26 categories ranging from less than $1,000 to $50,000 and over, and the other based on two categories for less than $20,000, and $20,000 and more. We recode the values for the 26 categories to their midpoint (using a value for the mean of the open-ended category calculated from the Pareto curve formula, Shryock and Siegel 1975:366). However, 14.4 percent of the respondents failed to answer this question. Because only 1.8 percent of the respondents are missing data on the second measure of income, we can use this information to estimate family income for the missing cases on the first measure. Specifically, those missing data on the first variable and indicating they have income below $20,000 on the second variable are given the mean income value among those with family income below $20,000; those missing data on the first variable and indicating they have income above $20,000 on the second variable are given the mean income value among those with family income above $20,000. For those missing data on both income variables, we assign the grand mean of family income. Finally, to adjust for family size, we divide family income by family size raised to the power of .38—an adjustment that measures income per household equivalent person and accounts for decreasing marginal expenses for each additional family member (Buhmann et al. 1988; van der Gaag and Smolensky 1982).
3. The Nam-Powers scale calculates status scores by averaging information on median education and income distributions for individuals in each occupation. It is normally distributed, has been refined over four decades, and provides hierarchical rankings of occupations.
4. Let D equal 1 for those in the labor force and 0 for those not in the labor force, and O equal occupational status as a centered variable with a mean of zero. The equation $Y = a + b_1 * D + b_2 * D * O$ reduces to $Y = a$ for those not in the labor force. Then, b_1 represents the average (i.e., when O equals its mean of 0) difference in Y between those out of and in the labor force, and b_2 represents the effect of O on Y for those in the labor force. About 3 percent of those without an occupation are employed or unemployed but do not provide information on their job. We treat those missing data on occupation as out of the labor force.
5. For former and current smokers who do not answer the question on the number of cigarettes smoked, we assign them to the moderate category. The assignment of values to the moderate category should minimize the influence of these cases on the results.
6. At the very oldest ages, mortality risks may decelerate (Horiuchi 1988), but we do not have enough cases of the "oldest old" to capture the effect.
7. There is some question about the causal direction of the relationship between socioeconomic status and health. However, the majority of studies demonstrate that socioeconomic status determines health rather than vice versa (Williams and Collins 1995). Furthermore, our data set is based on a non-institutionalized sample that excludes some of the least healthy individuals in the population.
8. These same results hold for an alternative measure of occupation based on the distinction between non-manual and manual jobs. With the dummy variable for non-manual occupation replacing the continuous status scale, the interaction of non-manual occupation with smoking remains negative. As before, high status moderates the harm of smoking for morbidity and self-rated ill health, but not mortality.
9. The exception involves an insignificant negative interaction of education in determining self-rated ill health for males.

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