BEING POOR AND COPING WITH STRESS: HEALTH BEHAVIORS AND CUMULATIVE DISADVANTAGE

September 23, 2005

Patrick M. Krueger
University of Pennsylvania

Virginia W. Chang
University of Pennsylvania

*We acknowledge support from the Robert Wood Johnson—Health and Society Scholars Program, University of Pennsylvania, the Center for Health Equity Research and Promotion, Philadelphia VAMC, and the NIH/National Institute of Child Health and Human Development K12HD043459.

ABSTRACT

We have two aims: first, to clarify whether health behaviors modify the relationship between stress and the risk of death, and second, to clarify whether, and if so, which health behaviors are more important for modifying stress among high or low socioeconomic status individuals. We use the 1990 Health Promotion and Disease Prevention supplement to the National Health Interview Survey, linked to the National Death Index, to examine the relationships among stress, health behaviors, socioeconomic status, and overall mortality, among U.S. adults.

There are complex relationships among socioeconomic status (SES), stress, and health behaviors. Compared to individuals with high SES, those who have low SES are more likely to smoke cigarettes, drink alcohol, and be sedentary, and, according to a recent study by Lantz and colleagues (2005), report higher levels of stress. At the same time, people often note that they undertake various behaviors—including smoking, drinking, and exercise—in part to mitigate their levels of stress (Revell et al. 1985). These issues frame our analyses in two ways. First, we examine whether various healthy and unhealthy behaviors mitigate the relationship between stress and mortality, or, said differently, whether stress modifies the relationship between health behaviors and mortality. Second, we examine whether those health behaviors are more or less effective in producing health or mitigating the relationship between stress and mortality among low SES individuals who may have less access to formal health care mechanisms, but experience greater stress due to their socioeconomic disadvantage.

SES, STRESS, HEALTH BEHAVIORS, AND HEALTH OUTCOMES

Prior research has examined the relationships among SES, health behaviors, and health outcomes (Blaxter 1990; Pampel and Rogers 2004); and the relationships among stress and health outcomes (Lantz et al. 2005). We review both of these bodies of literature, suggest connections between the two, and synthesize them to focus our attention on the complex relationships among SES, stress, health behaviors, and mortality.

SES, Health Behaviors, and Health and Mortality Outcomes

Pampel and Rogers (2004) provide an overview of the three theoretical debates that suggest a link between SES, health behaviors, and mortality. First, the Blaxter hypothesis suggests that compared to high SES individuals, low SES individuals may be harmed least by

their smoking and other poor health behaviors, because they are already at increased risks of various health conditions due to unhealthy work and living arrangements (Blaxter 1990). Thus, smoking may not be as pernicious to the health of low SES individuals as it would be for higher SES individuals who would otherwise have few barriers to good health.

Second and conversely, the social vulnerability hypothesis suggests that poor health behaviors may be worse for the health of low SES individuals than for the health of high SES individuals (Birch, Jerrett, and Eyles 2000). This perspective suggests that high SES individuals can use their economic resources to buffer the harm associated with poor health behaviors, through better medical care, more knowledge about how to manage their health, or more resources to care for their health. In contrast, low SES individuals may have greater health risks for numerous reasons, and they may be most likely to experience the adverse effects of poor health behaviors. This is consistent with the cumulative disadvantage perspective that suggests that multiple risk factors, such as low SES, poor health behaviors, and high stress may interact to produce worse health than would be suggested each factor alone (Ferraro and Kelley-Moore 2003).

Finally, Pampel and Rogers (2004) suggest the possibility of an additive relationship between health behaviors, SES, and mortality. For example, both smoking and low SES may be associated with worse health, but smoking may neither exacerbate nor mitigate the health risks associated with low SES. Some work finds support for this perspective (Kooiker and Christiansen 1995; Marangh-van d Mheen et al. 1999; Pampel and Rogers 2004).

Although prior work most consistently finds support for an additive relationship between smoking, SES, and health and mortality outcomes, that work is limited in two ways. First, much of the research focuses solely on smoking, and does not examine other important health

behaviors. The hypothesized relationships mentioned above could work for drinking and exercise, which, like smoking, have demonstrated relationships with mortality and are associated with SES (Rogers et al. 2000). Second, research in this area seldom accounts for the influence of stress. This is an important oversight, given that stress may be most common and deleterious among low SES individuals, and may be an important factor in shaping people's health behaviors. Indeed, if Blaxter's hypothesis relies on the notion that low SES individuals cope with their stressful circumstances by smoking, researchers that exclude stress when examining the relationship between SES and health behaviors may have mis-specified models.

Stress, Health Behaviors, and Health and Mortality Outcomes

Less work systematically examines the relationship between perceived levels of stress, health behaviors, and mortality outcomes. The literature typically describes stress as bad for individuals' health and focuses on subjective stress as a (poor) mental health outcome, or on bio-physiological indicators of stress (allostatic load) as a mediator between some social factor and mortality. However, little work examines whether the intersection between health behaviors and the subjective experience of stress—arguably the most important dimension of stress for shaping health behaviors—is associated with health and mortality outcomes.

Healthy or unhealthy behaviors may mitigate the relationship between stress and mortality. People often report that they manage their stress by smoking, drinking, or exercising (Revell 1985). If people perceive reduce levels of stress due to their smoking, drinking, or exercise behaviors, and if perceived stress is associated with mortality, than smoking, drinking, or exercise may be effective means for dealing with stress.

But some health behaviors may be more effective at mitigating the relationship between

stress and mortality than others. Exercise and moderate drinking are typically associated with lower risks of death. Thus, exercise and moderate drinking might be most beneficial for mitigating the relationship between stress and mortality. But current and former levels of smoking consistently shows a strong, graded, and positive relationship with the risk of premature death—increasing cigarette consumption results in higher risks of death, even after controlling for a wide array of covariates (Rogers et al. 2005). This is further complicated by that fact that although smokers may report that they smoke to deal with their stress, some studies find that those who quit smoking report less stress than when they smoked (Chassin et al. 2002). Thus, smoking may be an ineffective for mitigating the relationship between stress and mortality.

Nevertheless, research in this area is limited in two ways. First, little work examines whether, and if so, which health behaviors effectively mitigate the relationship between stress and the risk of death. Second, no research examines whether health behaviors more or less effectively mitigate the relationship between stress and mortality among those at different socioeconomic levels. We aim to clarify whether health behaviors modify the relationship between stress and mortality, and further, whether health behaviors are more important for modifying stress among high or low socioeconomic status individuals.

DATA AND METHODS

To examine the relationship between smoking and adult mortality in the United States, we employ the 1990 National Health Interview Survey Health Promotion and Disease Prevention (NHIS-HPDP) supplement. The NHIS is a nationally representative survey of the non-institutionalized population of the United States that includes annual information on a core set of questions that remain virtually unchanged from one year to the next, and records such variables

as age, sex, marital status, family size, income, education, and employment status. It also adds supplemental questions that vary from year to year. The NHIS-HPDP includes information on stress, smoking, drinking, and exercise, as well as important social and demographic variables, for 41,104 sample respondents aged 18 and older (NCHS 1993).

One of the most comprehensive mortality data sources available for the United States comes from matching the NHIS to the Multiple Cause of Death files (NHIS-MCD) via the National Death Index. The record linkage was accomplished through a probabilistic matching scheme that assigns weights to each of twelve 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 1993, 1996; NCHS 2000). Eliminating records with missing data on key variables and records that are ineligible to be linked to death certificates results in 36,592 individual records.[1] Matches to the MCD file through December of 1997 yield 3,097 deaths over the seven-year follow-up period (NCHS 1993, 2000). The important strengths of the data set include its nationally representative character, large size, breadth and depth of health behavior factors including cigarette smoking, relatively small amount of missing data, and high quality of matches between the NHIS and MCD files (Patterson and Bilgrade 1986).

Variables and measurement

We use two variables to create an index of the level of perceived stress that people report. One question asks about the amount of stress experienced in the last two weeks, and the other asks about the amount of stress experienced in the last year. Respondents reply on a four point scale that ranges from “a lot” to “almost none.” We take the standardized value of each variable to give them equal weight, and add them together. We set the minimum value to 0, with

increasingly positive values indicating higher levels of stress. The two variables are highly correlated (r=.68). When simultaneously entered into equations predicting mortality, they each retain independent relationships. Nevertheless, they behave identically in the various models we examine below. We create the index for the sake of parsimony—a single measure appears to accurately capture the relationship between each measure of stress and health (alpha=.81).

The health behaviors include drinking, cigarette smoking, and exercise. Our drinking variable comes from a question that asks individuals how many alcoholic drinks they have on days that they drink. This ranges from 0 (including those who report abstaining from alcohol) to 12 or more. We include a squared term to capture the well-known J-shaped relationship with drinking and mortality outcomes (Rogers et al. 2000). We include separate variables for current and former smokers who have smoked 100 or more cigarettes in their lives. For current smokers, we include the number of cigarettes they smoke each day, divided by 10. For former smokers, we include the number of cigarettes they smoked in a typical day, divided by 10. Both of these variables equal 0 for never smokers. We calculate exercise as an index that sums the standardized scores for whether individuals exercise regularly, how many years they have exercised regularly, and how they rate their level of activity compared to other persons of their age (alpha=.67).

The demographic control variables include age, sex, and race. We include age as a linear variable, ranging from 18 to 99 or older, and we include and age-squared term. We code sex categorically, with females as the referent. We control for race by comparing whites (the referent) to all others.

Socioeconomic variables include family income, education, and employment status. We control for the years of education individuals have attained as a linear variable that ranges from 0

to 18 or more. Further, we run our analyses separately for high and low socioeconomic groups. We divide individuals into those who have more than 12 years of education, and those who have 12 or fewer years; those who have the median or higher income, and those who have less than the median level of income; and those who are currently employed and those who are unemployed or not in the labor force. Except for family income, there is relatively little missing data for the variables. We imputed income because detailed values are missing for about 17% of the records.[3] Further, NHIS income categories are not equal intervals. For values under $50,000, we take the midpoint of the interval and divide it by 10,000, to approximate a continuous income value. Because the top category of $50,000 and above is open-ended and lacks a midpoint, we estimate a median value for this category.[4]

Hazards Models

We use Weibull hazards models to examine the risk of death over the up to 95 months between the date of interview and death, or censor at the end of 1997. When comparing the results between high and low SES individuals, we use "seemingly unrelated estimation" techniques, in Stata, to compare coefficients in different models. In all cases, we present the hazard coefficients because they are easier to interpret when looking at interaction terms. All coefficients and standard errors in the models are corrected for stratification and clustering in the sample design with Stata 8.2 software (StataCorp 2003).[5]

RESULTS

Table 1 presents the descriptive statistics.

(Table 1 about here)

Table 2 examines whether health behaviors modify the relationship between stress and overall mortality. Model 1 finds that higher levels of stress are associated with increased risks of mortality. Model 2 includes all of the health behaviors together. The number of drinks and individual consumes when drinking, exhibits the previously documented curvilinear relationship with mortality. Those who abstain or who drink very little, and those who consume many drinks, have higher risks of death than those who drink more moderately. Further, cigarette smoking is positively associated with the risk of death. As the number of cigarettes smoked daily for current smokers, or the number of cigarettes typically smoked by former smokers increases, the risk of death increases. Finally, increasing levels of exercise are associated with reductions in the risk of death over the follow-up period.

(Table 2 about here)

Model 3 includes multiplicative interactions between the health behaviors and stress, to examine whether the behaviors modify the relationship between stress and the risk of death. Several interesting patterns emerge. First, drinking clearly modifies the relationship between stress and the risk of death. Figure 1 graphically presents the relationships between stress and drinking in Model 3. Although drinking is unrelated to the risk of death for low stress individuals, the J-shaped relationship between drinking and mortality emerges as the level of perceived stress increases. Indeed, compared to those who drink between three and five drinks when they drink, those who abstain have 1.34 times the risk of death [1.34=exp(0.3)] and those who drink 12 or more drinks have 2.22 times the risk of death over the follow-up period.

(Figure 1 about here)

Model 3, Table 2, further shows that smoking modifies the relationship between stress and the risk of death. Both current and former smokers have increasing risks of death as the

number of cigarettes they currently or previously smoked, respectively, increases. Further, the risk of death for former smokers increases significantly as their perceived levels of stress increase. Figure 2 presents this relationship graphically. Current smokers who report high levels of stress, have the greatest risk of death over the follow-up period. Further, current smokers who report the lowest levels of stress also have very high risks of death. However, former smokers who smoked between 1 and 30 cigarettes in a typical day, who report very high levels of stress, have either the same or greater risks of death than those who currently smoke at those same levels. Further, the gap between high and low stress former smokers increases as the number of cigarettes formerly smoked increases.

(Figure 2 about here)

Finally, Model 3, Table 2, shows that exercise also modifies the relationship between stress and the risk of death. Although exercise generally reduces the risk of death, it is even more protective among those who also report high levels of stress. Figure three shows this relationship graphically. Although sedentary individuals who report the highest levels of stress have the highest risks of death over the follow-up period, with exercise, they can actually reduce their risks of death below that of low stress individuals who exercise.

(Figure 3 about here)

Table 3 examines the relationships among stress, health behaviors, and mortality, separately for high and low SES individuals. The first two columns compare those who have more than 12 years of education and those who have 12 or fewer years, respectively. Stress is not associated with the risk of death in the more educated sample, but shows a strong positive relationship with the risk of death over the follow-up period, for less educated individuals. Drinking is unrelated to the risk of death in either group—suggesting that splitting the sample

may have resulted in some loss of statistical power. Smoking modifies the relationship between stress and mortality in the more educated sample, but exercise is more important for modifying the relationship between stress and mortality in the less educated sample.

The next two columns compare those who have the median level of income or more and those who have less than the median level of income. Stress is associated with the risk of death in both samples, and similar to the results for education, drinking is unrelated to the risk of death in either group. Unlike the results for education, being a former smoker confers increased risks of death for the most stress low income individuals. However, similar to those who had low levels of education, among those who have low levels of income, exercise is an important behavior for mitigating the relationship between stress and the risk of death.

The final two columns compare those who are working and those who are unemployed or not in the labor force. Similar to the results for those who have low levels of education, stress is significantly associated with mortality among those who are not working but not among those who have jobs. Drinking shows a modest ability to modify the relationship between stress and the risk of death for those who are currently working, but not for those who are unemployed or not in the labor force. But, similar to the relationship found among those who have education and lower incomes, smoking status modifies the relationship between stress and the risk of death. Indeed, former smokers are at a particularly high risk of death if they also report high levels of stress. Finally, consistent with the findings among those who have low levels of education and lower incomes, exercise can modify the relationship between stress and the risk of death for those who are unemployed or not in the labor force.

CONCLUSION

We find strong support for the idea that health behaviors can modify the relationship between stress and mortality. In particular, moderate levels of drinking and increasing levels of exercise can mitigate the potentially harmful relationship between stress and the risk of death. We have found that among low stress individuals, the level of drinking is largely unrelated to the risk of death, and only as the level of stress increases, does the well-established J-shaped relationship between drinking and mortality manifest. This has not been established in prior work. Further, exercise is particularly advantageous for offsetting the mortality risks associated with stress.

In contrast, smoking appears to exacerbate the harmful effect of stress on the risk of death Although drinking and smoking are moderately correlated, and both have been thought of as potential coping behaviors with respect to stress, they have very different implications for the relationship between stress and mortality. Indeed, this further confirms or suspicion that smoking—even when used to cope with stress—has a strong and persistent association with the risk of death.

The interactions between stress and the health behaviors, by SES, are also illuminating. Among all three low SES groups (low education, low income, and not working), stress was significantly associated with the risk of death—a pattern that emerged only among one of the three high SES groups. Further, the interaction between stress and smoking appears to hold for those who have lower levels of income or who are currently not working, although the significant interaction among more educated individuals runs counter to this trend. This provides some, albeit inconclusive support for the social vulnerability perspective—but only once that perspective is amended to account for stress. These results run contrary to Blaxter's hypothesis

that the health consequences of behaviors such as smoking are attenuated by poverty.

Exercise is another behavior that is potentially stress-reducing, as well as more directly health enhancing than smoking. As with smoking, we find that exercise modifies the relationship between stress and health, although here we even more clearly find that it is important among low SES individuals. This further supports the social vulnerability perspective—not only do low SES groups exercise less, but the health consequences of doing so are potentially worse with high stress. These findings, together with the finding that our measure of stress does not show a clear association with SES (results not tabled), suggests that the quality and types of stress may vary in important ways between rich and poor, in ways that directly impact their survival prospects.

We plan to take the following steps to revise our paper before PAA. First, we will include a more complete set of covariates in our models, including marital status and controls for baseline health status. Second, we will test for statistical significance between high and low SES groups, either by running fully interactive models, or by using seemingly unrelated estimation procedures in Stata. Third, we will seek to replicate our results with other health outcomes, including self-rated health, and chronic and acute conditions. Finally, we will continue to revise the manuscript.

ENDNOTES

[1] About 1.9% of the NHIS-HPDP records, termed "ineligible," contain insufficient information to be matched to death records. NCHS identifies these records so that they may be dropped from the analysis (NCHS 2000). We dropped about 7.9% of the remaining individuals because of missing values for education, marital status, body mass index, smoking status, exercise, stress, physical activity, seat belt use, drinking status, or income.

[3] We use Ordinary Least Squares regression to estimate income separately for those with family incomes below $20,000, and for those with incomes equal to or above that amount—a question in the survey with a much higher response rate. We use age, age-squared, marital status, employment status, education, and race to predict income, and use the coefficients to impute values for those missing family income on the more detailed income variable.

[4] We find that an estimated median value is more reasonable than an estimated mean, and use the Pareto Curve to estimate the median. Parker and Fenwick (1983) note that the double log form of the Pareto Curve is linear at the upper tail of the income distribution, so that as the level of income in a category increases, the number of people in that category decreases. This allows them to estimate this slope, *v*, as:

$$\nu = \frac{\log(n_t + n_{t-1}) - \log(n_t)}{\log(x_t) - \log(x_{t-1})}$$

where n_t is the number of people in the open-ended category, n_{t-1} is the number of people in the income category immediate preceding the open-ended category, x_t is the lower limit of the open-ended category, and x_{t-1} is the lower limit of the penultimate category. They then use this value to estimate a median value (MD) for the category, as specified in Wright (1976:163):

$$MD = 10^{(.301/\nu)}(x_t)$$

Thus, for our analyses, we use the estimated median value of $68,645 for those individuals with a family income of $50,000 or more.

REFERENCES

Blaxter, Mildred. 1990. *Health and Lifestyles.* London: Tavistock.

Chassin, Laurie, Clark C. Presson, Steven J. Sherman, and Kyung Kim. 2002. "Long-Term Psychological Sequelae of Smoking Cessation and Relapse." *Health Psychology,* 21:438-43.

Ferraro, Kenneth F., and Jessica A. Kelley-Moore. 2003. "Cumulative Disadvantage and Health: Long-Term Consequences of Obesity." *American Sociological Review,* 68:707-29.

Kooiker, Sjoerd, and Terkel Christiansen. 1995. "Inequalities in Health: The Interaction of Circumstances and Health Related Behavior." *Sociology of Health and Illness.* 17:495-524.

Lantz, Paula M., James S. House, Richard P. Mero, and David R. Williams. 2005. "Stress, Life Events, and Socioeconomic Disparities in Health: Results from the American's Changing Lives Study. *Journal of Health and Social Behavior. ####.*

Marang-van de Mheen, Perla J., George Davey Smith, and Carole L. Hard. 1999. "The Health Impact of Smoking in Malual and Non-Manual Social Class Men and Women: A Test of the Blaxter Hypothesis." *Social Science and Medicine,* 48:1851-56.

Pampel, Fred C., and Richard. G. Rogers. 2004. "Socioeconomic Status, Smoking, and Health" A Test of Competing Theories of Cumulative Advantage. *Journal of Health and Social Behavior.* 45:306-21.

Revel, A.D., Warburton, D.M., and Wesnes, K. 1985. "Smoking as a Coping Strategy." *Addictive Behaviors,* 10:209-24.

Rogers, Richard G., Robert A. Hummer, and Charles Nam. 2000. *Living and Dying in the USA.* Academic Press.

Table 2: Weibull Hazard Coefficients for the Relationships Among Stress, Health Behaviors, and Mortality, U.S. Adults aged 18 and older.

	Model 1	Model 2	Model 3
Demographic Controls			
Age	0.740***	0.622***	0.610***
Age-squared	0.005***	0.018***	0.019***
Sex (male=1)	0.572***	0.495***	0.493***
Race (non-white=1)	-0.065*	-0.121***	-0.118***
Education	-0.047***	-0.028***	-0.028***
Stress, Health Behaviors, and Interactions			
Stress	0.077***	0.047***	0.094***
Number of drinks when drinking			
Number of drinks		-0.070*	-0.001
Number of drinks-squared		0.008**	0.000
Stress by number of drinks			-0.043***
Stress by number of drinks-squared			0.005***
Number of cigarettes smoked/10			
Number smoked for current smokers		0.260***	0.249***
Number smokded for former smokers		0.100***	0.065***
Stress by number smoked for current smokers			0.007
Stress by number smoked for former smokers			0.023***
Exercise			
Exercise index		-0.268***	-0.177***
Stress by exercise index			-0.067***
Constant	-11.977***	-11.789***	-11.819***

Notes

* $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$ (two-tailed tests).

Table 3: Weibull Hazard Coefficients for the Relationships Among Stress, Health Behaviors, and Overall Mortality, by Socioeconomic Status, U.S. Adults Aged 18 and Older.[a]

	Education		Income		Employment	
	More than 12 years	12 or fewer years	Median or higher	Less than the median	Currently working	Not currently working
Stress	0.007	0.144***	0.158*	0.076**	0.084	0.097***
Number of drinks when drinking						
Number of drinks	0.016	-0.008	-0.066	0.022	0.143	-0.055
Number of drinks-squared	0.005	-0.002	0.010	-0.004	-0.008	0.003
Stress by number of drinks	-0.061	-0.030	-0.038	-0.036	-0.083*	-0.014
Stress by number of drinks-squared	0.006	0.003	0.004	0.004	0.007	0.002
Number of cigarettes smoked/10						
Number smoked for current smokers	0.276***	0.239***	0.302***	0.225***	0.239***	0.246***
Number smokded for former smokers	0.018	0.076***	0.093*	0.055**	0.078	0.045*
Stress by number smoked for current smokers	0.021	0.000	-0.013	0.014	0.030	-0.002
Stress by number smoked for former smokers	0.048**	0.018	0.013	0.028**	-0.001	0.038***
Exercise						
Exercise index	-0.297***	-0.117**	-0.229**	-0.170***	-0.174	-0.183***
Stress by exercise index	0.050	-0.139***	0.009	-0.092***	0.021	-0.096***

Notes

* $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$ (two-tailed tests).

[a] These models further control for age, age-squared, sex, and race.

Figure 1: Risk of Death by Number of Drinks when Drinking, For High and Low Stress

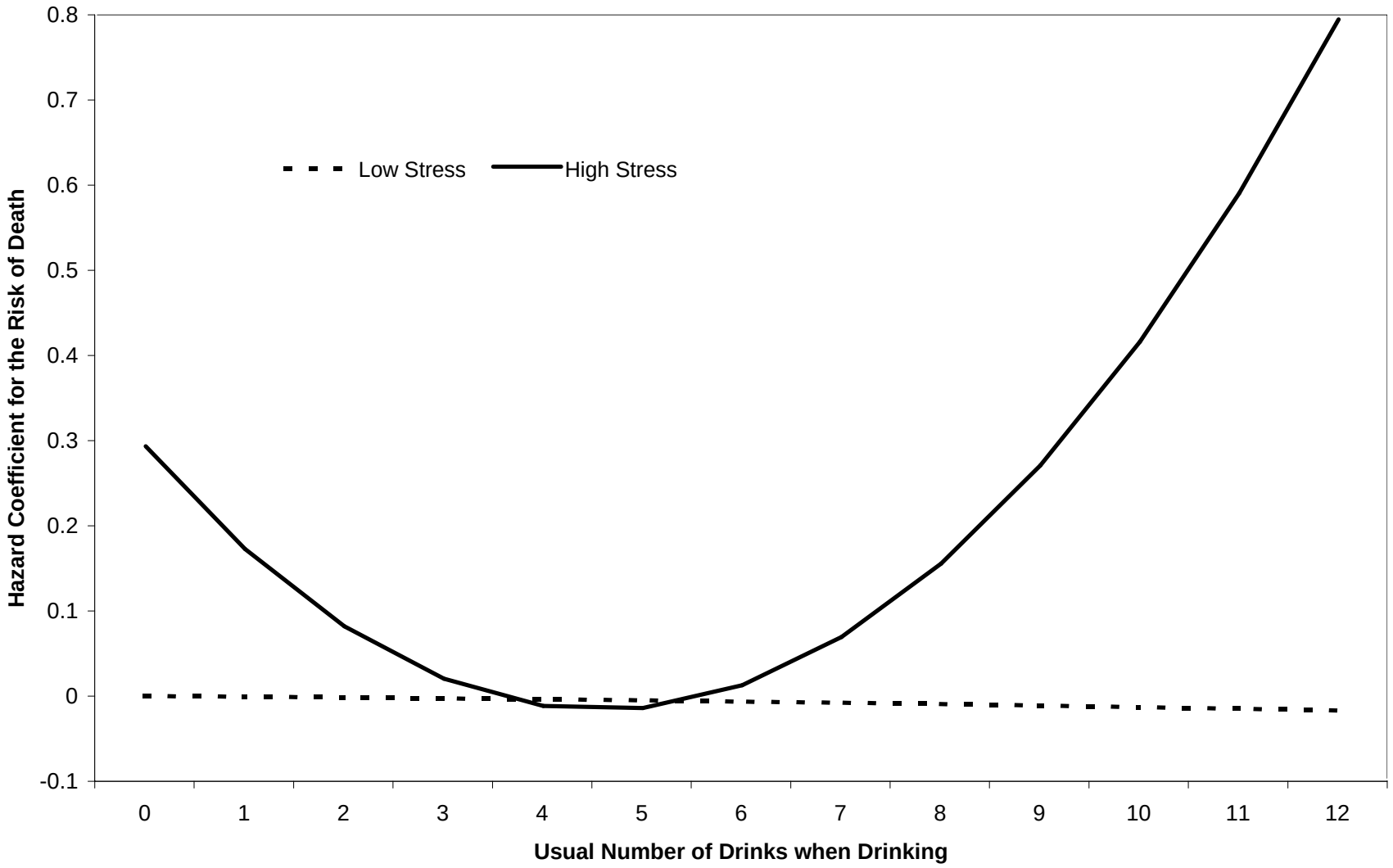

Figure 2: Risk of Death by Number of Cigarettes Currently or Formerly Smoked, For High and Low Stress

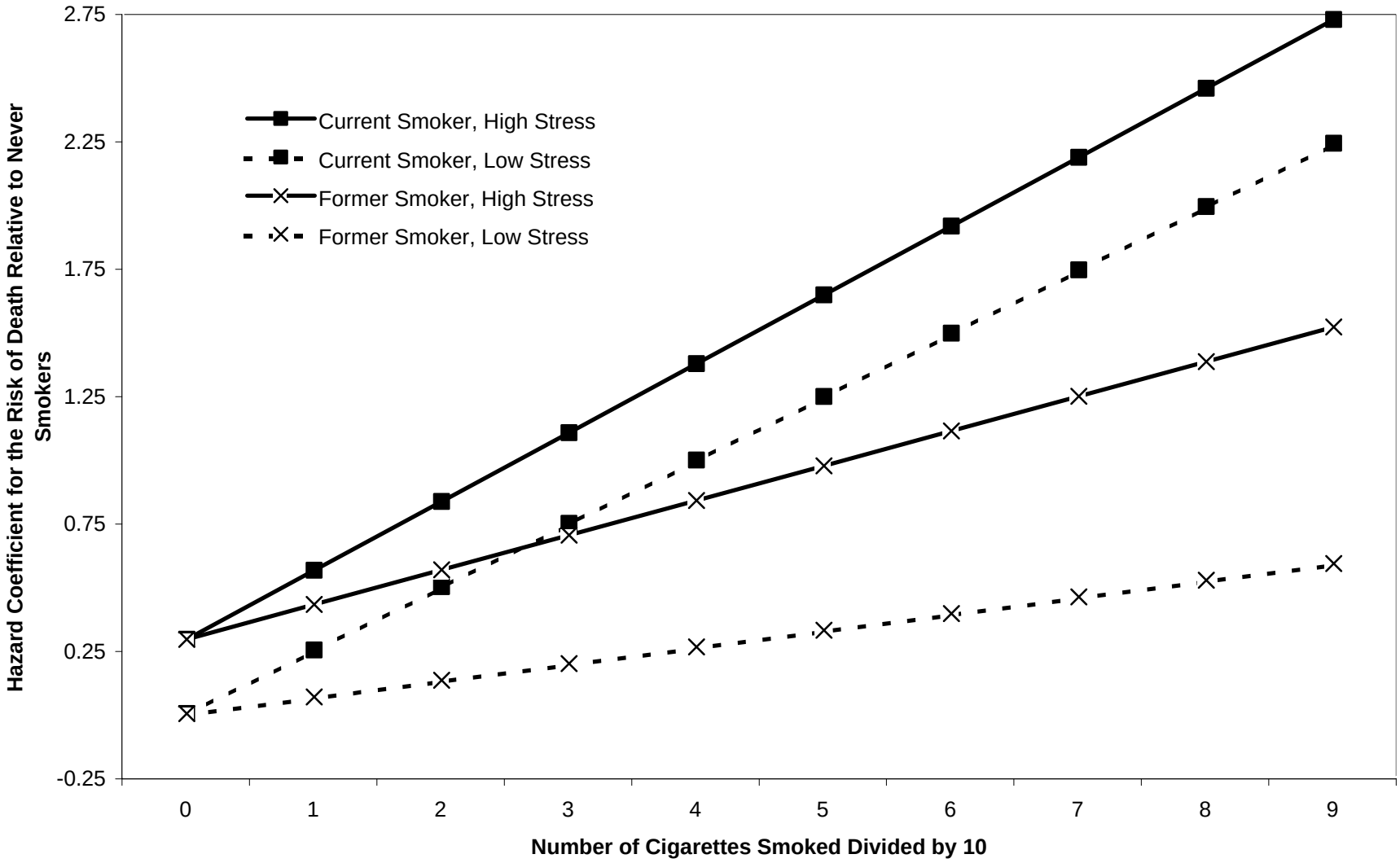

Figure 3: Risk of Death by Level of Exercise, For High and Low Stress