THE LINKS BETWEEN EDUCATION AND HEALTH*

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The positive association between education and health is well established, but explanations for this association are not. Our explanations fall into three categories: (1) work and economic conditions, (2) social-psychological resources, and (3) health lifestyle. We replicate analyses with two samples, cross-sectionally and over time, using two health measures (self-reported health and physical functioning). The first data set comes from a national probability sample of U.S. households in which respondents were interviewed by telephone in 1990 (2,031 respondents, ages 18 to 90). The second data set comes from a national probability sample of U.S. households in which respondents ages 20 to 64 were interviewed by telephone first in 1979 (3,025 respondents), and then again in 1980 (2,436 respondents). Results demonstrate a positive association between education and health and help explain why the association exists. (1) Compared to the poorly educated, well educated respondents are less likely to be unemployed, are more likely to work full-time, to have fulfilling, subjectively rewarding jobs, high incomes, and low economic hardship. Full-time work, fulfilling work, high income, and low economic hardship in turn significantly improve health in all analyses. (2) The well educated report a greater sense of control over their lives and their health, and they have higher levels of social support. The sense of control, and to a lesser extent support, are associated with good health. (3) The well educated are less likely to smoke, are more likely to exercise, to get health check-ups, and to drink moderately, all of which, except check-ups, are associated with good health. We conclude that high educational attainment improves health directly, and it improves health indirectly through work and economic conditions, social-psychological resources, and health lifestyle.

The positive association between education and health is well established, but explanations for this association are not. Well educated people experience better health than the poorly educated, as indicated by high levels of self-reported health and physical functioning and low levels of morbidity, mortality, and disability. In contrast, low educational attainment is associated with high rates of infectious disease, many chronic noninfectious diseases, self-reported poor health, shorter survival when sick, and shorter life expectancy (Feldman, Makuc, Kleinman, and Cornoni-Huntley 1989; Guralnik, Land, Fillenbaum, and Branch 1993; Gutzwiller, LaVecchia, Levi, Negri, and Wietlisbach 1989; Kaplan, Haan, and Syme 1987; Kitagawa and Hauser 1973; Liu, Cedres, and Stamler 1982; Morris 1990; Pappas, Queen,

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Hadden, and Fisher 1993; Syme and Berkman 1986; Williams 1990; Winkleby, Jatulis, Frank, and Fortmann 1992; Woodward, Shewry, Smith and Tunstall-Pedoe 1992).[1] The positive association between health and socioeconomic status, whether measured by education, occupation, or income, is largely due to the effects of SES on health, not vice versa, and downward mobility among persons in poor health cannot explain the association (Doornbos and Kromhout 1990; Fox, Goldblatt, and Jones 1985; Power, Manor, and Fogelman 1990; Wilkinson 1986).

INEQUALITY AND HEALTH

Why is education associated with good health? Our theoretical explanations fall into three categories: (1) work and economic conditions, (2) social-psychological resources, and (3) health lifestyle. According to the first explanation, well educated people are less likely to be unemployed, and more likely to have full-time jobs, fulfilling work, high incomes, and low economic hardship. According to the second, the well educated have social-psychological resources, including a high sense of personal control and social support, in addition to economic resources. According to the third, the well educated have healthier lifestyles; compared to the poorly educated, the well educated are more likely to exercise, to drink moderately, to receive preventive medical care, and less likely to smoke.

We focus on education as the aspect of socioeconomic status most important to health—not to the exclusion of work and income, but as the variable that structures the other two.[2] Education is the key to one's position in the stratification system; it shapes the likelihood of being unemployed, the kind of job a person can get, and income.

Sociologists study stratification out of interest in systematic differences in opportunities and quality of life. Although stratification research typically focuses on job-related outcomes such as occupation and earnings, ultimately the impact of social inequality extends beyond differences in jobs, earnings, prestige, and power, to the consequences of this inequality for individual well-being. If educational inequality leads to differences in health then it directly affects quality of life. Education-based inequality sorts people into different positions that are associated with different risks and rewards. Location in the stratification system shapes the ongoing stressors to which people are exposed, the resources available to help them cope with stressors, and lifestyle (Pearlin 1989). We argue that the advantages of the well educated in work and economic circumstances, social-psychological resources, and lifestyle improve health.

Although sociologists have called for research on the *explanations* for the association between socioeconomic status and health, little U.S. research has been done (Pearlin 1989; Williams 1990).[3] Those who study education's effect on the subjective quality of life often downplay its importance, claiming educational attainment is credentialism with little real value, and that education has a questionable payoff in terms of access to fulfilling and satisfying work (Berg

[1] There are exceptions to this general pattern. For example, well educated women have higher rates of breast cancer than the poorly educated, largely because they have fewer children, which increases risk. However, among women with breast cancer, well educated women survive longer than the poorly educated (Lipworth, Abelin, and Connelly 1970).

[2] Some researchers pit various aspects of socioeconomic status against one another, asking, for example, which is a better predictor of risk factors for cardiovascular disease—education, occupation, or income (Winkleby et al. 1992)? This ignores causal interrelationships among the three aspects of SES: Not only is education a strong predictor of health when occupation and income are adjusted, but a direct effect of education (net of occupation and income) underestimates the total effect of education that works indirectly by way of jobs and income.

[3] In U.S. research, education is typically a control variable, statistically controlled in a study whose focus is on other variables (Pearlin 1989). Sociologists of health often ignore key sociological variables in studies of well-being, instead focusing on variables like life events, which are not grounded in the stratification system (Pearlin 1989:241). In contrast, social scientists studying the developing world see education as "the most influential investment" a country can make, improving skills, wages, economic well-being, birth control, hygiene, living conditions, health of children and adults, and life expectancy (Summers 1992:132).

1971; Quinn and Mandilovitch 1977). A study by Leigh (1983), one of the few that examines the indirect effects of education on self-reported health in the United States, has limitations. First, it uses an economic, individual choice perspective which asserts that poorly educated people "chose" hazardous jobs due to lack of knowledge; second, it excludes the nonemployed, thus excluding people who are the most disadvantaged. Leigh finds that the relatively dangerous work done by the poorly educated explains some of the effect of education on health, but that income does not significantly affect health and therefore cannot explain any of the effect. He concludes that income and medical care are inconsequential to health (he equates income with medical care and has no independent measure of the latter), as if the only drawback to poverty was the inability to purchase medical care. We question Leigh's conclusions. First, we view income and medical care as conceptually distinct, rather than as interchangeable explanations. Second, the *apparent* insignificance of income may reflect a truncated sample (of employed persons) that eliminates the most disadvantaged: those who are unemployed, engaged in unpaid domestic labor, and retired.

We include persons who are not in the paid economy, and thus, we do not measure work characteristics as occupational prestige, rank, or status. Because occupational prestige (or occupational status ranked from unskilled at the bottom to professionals, managers, and executives at the top) is relevant only to the employed, studies that use it exclude everyone who is not employed. Much of the *descriptive* research on social class and health is British, and almost all of it equates social class with occupation (e.g., Wilkinson 1986). By one estimate 42 percent of British women aged 16 to 64 were excluded from these studies because they had "no occupation" (Carstairs and Morris 1989). The exclusion of people not employed for pay eliminates the most disadvantaged, severely truncates variation in socioeconomic status, and attenuates the effects of educational and economic inequality on health.

"Social inequality" and "individual responsibility" are often considered rival explanations of health. The view that health is determined by individual behaviors, like smoking (Knowles 1977), is criticized by those who see health as a function of a social structure that allocates goods unequally (Crawford 1986). In contrast, in the theory we develop, social-psychological resources and health behaviors link structured inequality to health. Stressors, hardships, beliefs, and behaviors are not randomly distributed; they are socially structured. Smoking, exercising, drinking, or a sense of personal control are not *alternatives* to socially structured inequalities like unemployment, poverty, unfulfilling jobs, or economic hardships faced disproportionately by those with little schooling. On the contrary, they link education-based inequality to health.

Work and Economic Conditions

Education shapes work and economic conditions. Well educated people are less likely to be unemployed than the poorly educated; they are more likely to work full-time, and their work may be more fulfilling. Their incomes are higher, and they experience less economic hardship. Thus, the work and economic conditions of the well educated may protect their health.

Employment. The well educated are more likely to be employed: Among persons aged 25 to 34 in 1991, 87 percent of college graduates were employed, compared to 77 percent of those with only a high school degree, and 56 percent of those with eight years of education or less (U.S. Department of Education 1992). The unemployment rate for college graduates was 3 percent, one-fifth of that for persons with some high school. Lack of education limits employment opportunities (Sewell and Hauser 1975), and it is the poorly educated who work at low-status, poorly paid jobs who have the greatest risk of losing their jobs in an economic downturn (Elder and Liker 1982). Among the employed, the well educated are more likely to work full-time. In comparison, part-time work offers less training, lower returns to experience, and fewer benefits (Holden and Hansen 1987).

Employment benefits men's and women's well-being, while unemployment is associated with ill health (Linn, Sandifer, and Stein 1985; Pearlin, Lieberman, Menaghan, and Mullan 1981). Long confirmed for men, it has

been established recently that among women the employed report the best physical health (Bird and Fremont 1991; Verbrugge 1983); housewives report lower health, and unemployed women report the worst health (Jennings, Mazaik, and McKinlay 1984). Part-time female workers have worse health than full-time female workers, although their health is better than the nonemployed (Herold and Waldron 1985). This positive association between employment and health is not simply due to selection of healthier people into the labor force (Kessler, House, and Turner 1987; Moser, Fox, and Jones 1986; Passannante and Nathanson 1985; Ross and Mirowsky forthcoming). We expect that the higher likelihood of and levels of employment among the well educated positively affect their health.

Income and economic hardship. Education shapes employment, income, and in turn economic hardship. Low educational attainment translates into low expected income (Sewell and Hauser 1975), which in turn is the major cause of economic hardship. Yet even at the same income levels, poorly educated people experience greater hardship than the well-educated (Ross and Huber 1985). The effect of poverty and lack of education on economic strain is synergistic; each factor makes the effect of the other worse. Education provides skills and information to help people deal with the stresses of life, including a low income, while lack of education makes it more difficult to cope with an inadequate income.

Economic hardship negatively impacts health. The ongoing strain of paying the bills on an inadequate income takes its toll. When life is a constant struggle, when it is never taken for granted that there will be enough money for food, clothes, and shelter, people often feel worn down, depressed, and hopeless, which decreases resistance and makes them susceptible to disease (Pearlin et al. 1981; Syme and Berkman 1986)

Work fulfillment. We expect that education gives people access to subjectively rewarding work, but the evidence is indirect. Well educated people are more likely than the poorly educated to experience autonomy on the job and nonroutine work, both of which increase psychological functioning and job satisfaction (Kohn, Naoi, Shoenbach, Schooler, and Slomczynski 1990; Ross and Reskin 1992). We expect that work done by people with a high school education or less is not as rewarding subjectively as work done by college graduates—that it is less enjoyable, provides fewer opportunities to learn new things and develop as a person, and results in less pride in accomplishments and less recognition from others. Work characterized by job insecurity, monotony, and exclusion from decision-making may be less subjectively rewarding. However, the health effects of intrinsic work rewards among the employed are small, inconsistent, and not always positive (Hibbard and Pope 1987; House, Strecher, Metzner, and Robbins 1986). Past research on education, work fulfillment, and health is inconclusive.

Social-Psychological Resources

Education shapes two key social-psychological resources: a sense of personal control and social support—both of which may protect health.

Sense of control. A sense of control over one's life may be an important link between education and health. Perceived powerlessness and lack of control is the belief that one's actions do not affect outcomes (Seeman 1983)—that outcomes of situations are determined by forces external to one's own actions such as powerful others, luck, fate, or chance. The opposite, belief in personal control, is a learned expectation that outcomes are contingent on one's own choices and actions—that one can master, control, or effectively alter one's environment. This sense of personal control appears in the literature in a number of related forms with various names, including locus of control (Rotter 1966), personal efficacy (Downey and Moen 1987), personal autonomy (Seeman and Seeman 1983), self-directedness (Kohn and Schooler 1982), mastery (Pearlin et al. 1981), and instrumentalism (Wheaton 1980).

Education, employment, and income increase the sense of personal control (Mirowsky and Ross 1989; Pearlin et al. 1981; Ross and Mirowsky 1992; Wheaton 1980). Through education, one develops capacities on many levels that increase one's sense of personal control, mastery, and self-direction: the habits and skills of communication (read-

ing, writing, inquiring, discussing, looking things ups, and figuring things out); and analytic skills (mathematics, logic, and, on a more basic level, observing, experimenting, summarizing, synthesizing, interpreting, and classifying). Because education develops one's ability to gather and interpret information and to solve problems on many levels, it increases one's potential to control events and outcomes in life. Moreover, through education one encounters and solves problems that are progressively more difficult, complex, and subtle, which builds problem-solving skills and confidence in the ability to solve problems. Education instills the habit of meeting problems with attention, thought, action, and persistence. In contrast, people with low levels of educational attainment and restricted employment opportunities and economic circumstances often learn that failure is built into their lives. Through experience, they come to perceive that powerful others and unpredictable forces control their lives and that they cannot get ahead no matter how hard they try.

The sense of personal control improves health, first, through enhancing health-related behaviors. People with high personal control are more knowledgeable about health, are more likely to initiate preventive behaviors such as quitting smoking or reducing alcohol consumption and, as a consequence, report better self-rated health and fewer illnesses than those with a low sense of control (Seeman and Seeman 1983; Seeman, Seeman, and Budros 1988). Second, lack of personal control affects health through physiological mechanisms, because experiences of uncontrollability and the resulting demoralization are associated with suppression of the immune system (Rodin and Timko 1992; Rowe and Kahn 1987).

Social support. Social support is a sense of being cared for and loved, esteemed and valued as a person, and part of a network of communication and mutual obligation in which others can be counted on (Cobb 1976). The well educated have higher levels of social support than the poorly educated (Eckenrode 1983; Ross and Mirowsky 1989). Unemployment and economic hardship (associated with low educational attainment) decrease the sense of having a supportive spouse and increase domestic arguments (Gore 1978; Atkinson, Liem, and Liem 1986). Thus, the very people who most need social support to cope with their disadvantaged social positions are least likely to have it.

Social support improves health and decreases mortality (House, Landis, and Umberson 1988). The age-adjusted mortality for men with few social connections is 2.3 times higher than that for men with many connections; for women it is 2.8 times higher (Berkman and Breslow 1983). Social support improves health through psychological and behavioral mechanisms. It decreases depression, anxiety, and other psychological problems (Kessler and McLeod 1985; LaRocco, House, and French 1980). Over time, psychological distress worsens subsequent physical well-being (Aneshensel, Frerichs, and Huba 1984), and, in a 15-month follow-up, the severely depressed were four times more likely to die than others, adjusting for health conditions and physical functioning (Bruce and Leaf 1989). Also, social support may increase the likelihood of practicing protective health behaviors. For instance, married people experience more regulation of behavior than the unmarried (Umberson 1987), as one's spouse may discourage smoking, drug use, or heavy drinking.

Health Lifestyle

Compared to the poorly educated, well educated people more frequently engage in positive health behaviors, like exercising, not smoking, and not drinking heavily—behaviors that may protect their health.

Smoking. The well educated are less likely to smoke than the poorly educated because they are more likely to have never smoked and because they are more likely to have quit (Helmert, Herman, Joeckel, Greiser, and Madans 1989; Jacobsen and Thelle 1988; Liu et al. 1982; Matthews, Kelsey, Meilahn, Kuller, and Wing 1989; Millar and Wigle 1986; Shea et al. 1991; Wagenknecht et al. 1990; Winkleby et al. 1992). Smoking negatively affects health. Of all the practices that affect health, smoking has the the largest number of negative consequences (Rogers and Powell-Griner 1991). It increases the risk of coronary heart disease, stroke, atherosclerosis, aneurysms; lung and other cancers, including esophagus, pancreas, bladder, larynx,

and cervix; emphysema, bronchitis, pneumonia, and other respiratory infections; liver disease; and burns. Smoking is also associated with poor self-reported health (Abbott, Yin, Reed, and Yano 1986; NCHS 1989; Segovia, Bartlett, and Edwards 1989; Surgeon General 1982; U.S. Preventive Services Task Force 1989). Heart disease, cancer, stroke, and emphysema alone account for about 65 percent of all deaths (NCHS 1992).

Exercise. High levels of educational attainment are positively associated with physical activity (Ford et al. 1991; Helmert et al. 1989; Jacobsen and Thelle 1988; Leigh 1983; Shea et al. 1991), which positively affects many health outcomes. Compared to inactivity, any physical activity, aerobic or nonaerobic, reduces mortality (Berkman and Breslow 1983). Exercise reduces cardiovascular risk, back pain, osteoporosis, atherosclerosis, colon cancer, obesity, high blood pressure, constipation, varicose veins, and adult onset diabetes, and improves subjective health reports (Berlin and Colditz 1990; Caspersen, Bloemberg, Saris, Merritt, and Kromhout 1992; Duncan, Gordon, and Scott 1991; Leon, Connett, Jacobs, and Rauramaa 1987; Magnus, Matroos, and Strackee 1979; Paffenbarger et al. 1993; Sandvik et al. 1993; Segovia et al. 1989; U.S. Preventive Services Task Force 1989).

Drinking. The well educated are more likely to drink moderately than the poorly educated. In contrast, people with lower levels of education are more likely to abstain from or to abuse alcohol (Darrow, Russell, Copper, Mudar, and Frone 1992; Midanik, Klatsky, and Armstrong 1990; Romelsjo and Diderichsen 1989). Heavy drinking may temporarily relieve the stresses of poverty or low-level, high-risk jobs available to those with little schooling (Shore and Pieri 1992).

Compared to smoking and sedentary lifestyle, drinking as a risk factor is implicated in only 4 of the leading 15 causes of death—car accidents (one of the top 5 causes of death), cirrhosis of the liver, suicide, and homicide. Of these, only cirrhosis and injuries from car accidents affect self-reported health, making drinking far less ubiquitous in its health consequences than smoking or inadequate physical activity. Furthermore, research indicates a U-shaped relationship between drinking and illness. Both abstainers and very heavy drinkers have higher mortality and morbidity than do those who drink moderately (Berkman and Breslow 1983; Guralnik and Kaplan 1989; Midanik et al. 1990). Moderate drinking, as compared to abstinence, is associated with lower risk of coronary heart disease, stroke, and hypertension, whereas very heavy drinking is associated with higher risk (Gaziano et al. 1993; Gill, Zezulka, Shipley, Gill, and Beevers 1986; Stampfer, Colditz, Willet, Speizer, and Hennekens 1988).

Health check-ups. The well educated are more likely to get preventive medical care—annual physical exams, immunizations, and screening—than are the poorly educated (Coburn and Pope 1974). They are more likely to have health insurance and to belong to social networks that encourage preventive behavior. Theoretically, annual physical exams help detect early signs of illness, thus forestalling more serious health problems. Little research has examined the efficacy of health check-ups, but existing studies indicate little support for an association between annual physical exams and improved health (Canadian Task Force on the Periodic Health Examination 1979, 1988; U.S. Preventive Services Task Force 1989). Nonetheless, it is possible that one way education protects health is by increasing access to preventive medical care.

DATA AND MEASURES

Work, Family, and Well-Being

The Work, Family, and Well-Being (WFW) sample is based on a 1990 telephone survey of a national probability sample of U.S. households. Random digit dialing was used to ensure the inclusion of unlisted numbers (Waksberg 1978). Within each household, the person 18-years old or older with the most recent birthday was selected as respondent, which is an efficient method to randomly select a respondent within the household (O'Rourke and Blair 1983). The response rate of 82.3 percent yielded a total of 2,031 respondents ranging in age from 18 to 90.

Measuring education and sociodemographic characteristics. *Education* is coded as number of years of formal education completed. *Sex* is coded 1 for males; 0 for fe-

males. *Age* is coded as age in years. *Race* is coded 1 for Whites; 0 for non-Whites and Hispanics. *Marital status* is a dummy variable contrasting those currently married or living together as married (coded 1) with those who are single, separated, divorced or widowed (coded 0).

Measuring health. Health is measured as self-reported health and physical functioning. *Self-reported health* is the respondent's subjective assessment of his or her general health (coded 1 = very poor, 2 = poor, 3 = satisfactory, 4 = good, 5 = very good). Self-reported health is a valid and reliable measure of general physical well-being (Davies and Ware 1981; Mossey and Shapiro 1982). It combines the subjective experience of acute and chronic, fatal and nonfatal diseases, and general feelings of well-being, like feeling run-down and tired, having backaches and headaches. Thus, it measures health as defined by the World Health Organization—as a state of well-being, not simply as the absence of disease. Self-reported health is highly correlated with more "objective" measures, such as physician's assessments, and with measures of morbidity and mortality (Idler and Kasl 1991; Kaplan 1987; Mossey and Shapiro 1982), and it is a predictor of mortality over and above measures of chronic and acute disease, physician assessment made by clinical exam, physical disability, and health behaviors (Davies and Ware 1981; Idler and Kasl 1991; Liang 1986). In fact, self-assessed health is a *stronger* predictor of mortality than is physician-assessed health (Mossey and Shapiro 1982).

Physical functioning assesses physical mobility and functioning in daily activities. All information in surveys consists of "self-reports," but physical functioning may not be as subjective as perceived health. Although self-reported health is highly correlated with morbidity, differences in the meaning, interpretation, or awareness of health and illness may shape socioeconomic differences in self-reported health. Therefore we also measure physical functioning, using an index of seven items. Respondents were asked "How much difficulty do you have (1) going up and down stairs; (2) kneeling or stooping; (3) lifting or carrying objects less than 10 pounds, like a bag of groceries; (4) using your hands or fingers; (5) seeing, even with glasses; (6) hearing; (7) walking?" (coded 0 = a great deal of difficulty, 1 = some difficulty, and 2 = no difficulty). The physical functioning index is the average of the 7 items, scored from 0 to 2. The low end of the scale reflects high physical impairment or disability; the high end reflects high physical functioning. This index is conceptually similar to Nagi's (1976) disability scale (alpha reliability = .804).

Measuring work and economic conditions. *Employment status* is measured using four categorical variables: employed full-time, employed part-time, not employed for pay (the comparison group in the regression analyses), and unable to work because of disability/illness. Inability to work because of disability or illness is included to control for the selection of some people out of the labor force because of illness, which will allow us to examine whether employment is associated with improved health, holding selection effects constant. *Household income* is coded in thousands of dollars per year. *Economic hardship* is measured as the response to three questions, "During the past twelve months, how often did it happen that you (1) did not have enough money to buy food, clothes, or other things your household needed; (2) did not have enough money to pay for medical care; and (3) had trouble paying the bills?" Responses to each question were coded from 0 to 3 (0 = never, 1 = not very often, 2 = fairly often, and 3 = very often). The economic hardship index is the mean response to the three questions (alpha reliability = .82).

Work fulfillment is measured as fulfillment from work, either paid or unpaid. We asked employed and nonemployed persons to describe the work, tasks, or activities they most frequently do during the day. Respondents were then asked about the subjective rewards of their primary daily work. Paid work is considered the primary daily work of people working for pay 20 hours per week or more. Unpaid work includes reported activities such as housework, childcare, care for an ill or elderly family member, volunteer work, gardening and home repair, looking for work, and so on. Work fulfillment, or intrinsic gratification from work, includes pride in one's work, enjoyment of work, and the sense of learning and developing as a person through work. Work fulfillment is measured by responses to three questions: "How often do you finish

your work/daily activities with a good feeling that you have done something especially well?" (Coded –2 = never, –1 = once in a while, 0 = neutral, 1 = pretty often, 2 = very often); "How much do you agree with the statements: 'My work/tasks give me a chance to do things I enjoy'; and 'My work/tasks give me a chance to develop and to learn new things'?" (Coded –2 = strongly disagree, –1 = disagree, 0 = neutral, 1 = agree, 2 = strongly agree). The work fulfillment index is the average response to these three questions; high scores indicate high work fulfillment.

Measuring social-psychological resources. *Sense of control* is the belief that you can and do master, control, and shape your own life. Perceived lack of control, the opposite, is the expectation that one's behavior does not affect outcomes. Sense of control is measured by a 2 × 2 index that balances statements claiming or denying control over good or bad outcomes (Mirowsky and Ross 1991; details of measurement are shown in Appendix A).

Social support is measured by responses to two questions about emotional support: "How much do you agree with the statements: 'I have someone I can turn to for support and understanding when things get rough,' and 'I have someone I can really talk to'?" (coded –2 = strongly disagree, –1 = disagree, 0 = neutral, 1 = agree, 2 = strongly agree). The social support index is the mean response; high scores indicate high support.

Measuring health lifestyle. *Exercise* is an index of walking and strenuous exercise. Walking is measured as the number of days walked per week. Respondents were asked, "How often do you take a walk? Would you say never (= 0), once a month or less (= .25), about twice a month (= .5), about once a week (= 1), twice a week (= 2), three times a week (= 3), more than three times a week (= 5), or every day (= 7)?" Strenuous exercise is measured by asking respondents, "How often do you do strenuous exercise such as running, basketball, aerobics, tennis, swimming, biking, and so on?" (coded the same way as walking, with the exception that more than three times a week is the highest response category). Our exercise index is the mean response to these two questions.

Smoking is coded 0 for nonsmokers, 1 for persons who have ever smoked seven or more cigarettes a week but who do not currently smoke, and 2 for persons who currently smoke seven or more cigarettes a week.

National Survey of Personal Health Practices and Consequences

The National Survey of Personal Health Practices and Consequences (Health Practices, or HP) sample is a national probability sample of U.S. households, collected by telephone in 1979; respondents were re-interviewed in 1980. Telephone exchanges were first randomly selected; next a random sample of telephone households were selected in proportion to the number of households served by each exchange; last, a sample respondent was chosen from each eligible household. There are 3,025 respondents, ages 20 to 64, interviewed in 1979; 2,436 were re-interviewed in 1980. Nonrespondents in 1980 do not differ significantly from respondents in terms of 1979 household income, education, employment status, or marital status. However, nonrespondents were younger and less likely to be White.

Measuring education and sociodemographic characteristics. *Education* is coded ordinally in years of formal education completed (0 = none, 2.5 = 1 to 4 years, 5.5 = 5 to 6 years, 7.5 = 7 to 8 years, 10 = 9 to 11 years, 12 = 12 years, 14 = 13 to 15 years, 16 = college degree or more. *Sex* is coded 1 for males; 0 for females. *Age* is coded as age in years. *Race* is coded 1 for Whites; 0 for non-Whites. *Marital status* is a dummy variable contrasting those currently married (coded 1) with those who are single, separated, divorced, or widowed (coded 0).

Measuring health. *Self-reported health* combines answers to two questions, "Would you say your health is . . . ," and "Compared to other people your age, would you say your health is . . . poor (= 1), fair (= 2), don't know (= 3), good (= 4), excellent (= 5)." Self-reported health is the mean response to the two questions and is scored from poor to excellent health.

Physical functioning is a five-variable index. Respondents were asked "do you have any trouble or difficulties (1) walking; (2) using stairs or inclines; (3) standing or sitting for long periods; (4) using your fingers to grasp or handle; (5) lifting or carrying some-

thing as heavy as 10 pounds" (coded 0 = yes, a great deal of difficulty; 1 = yes, some difficulty; 2 = no). The index is the mean response to the five items (alpha reliability = .846).

Measuring work and economic conditions. *Employment status* is measured using four categorical variables: employed full-time, employed part-time, not employed for pay (the comparison group in the regression analyses), and unable to work because of poor health (coded 1 if retired because of health; 0 otherwise). *Household income* is measured according to the following categories: 4 = less than $5,000, 7.5 = $5,000 to $9,000, 12.5 = $10,000 to $14,999, 20 = $15,000 to $24,999, 30 = $25,000 or more. *Economic hardship* is measured by the responses to two questions: "Does it ever happen that you do not have enough money to afford the kind of medical care you or your family should have?" and "Please tell me if a serious financial difficulty or problem happened in your life during the past five years" (coded 0 = no and 1 = yes). The economic hardship index is the sum of responses.

Measuring social-psychological resources. *Sense of control* is measured as the sense of control over one's future health. Respondents were asked, "How much control do you think you have over your future health?" (coded 1 = none at all, 2 = very little, 3 = some, 4 = a great deal). *Social support* is measured by responses to three questions: "How many close relatives do you have? These are people that you feel at ease with, can talk to about private matters and can call on for help"; "How many friends do you have that you feel really close to? These are friends that you feel at ease with, can talk to about private matters, and can call on to help" (coded 0 = none, 1 = one, 2 = two, 3 = three, 4 = four or more); and "Do you feel that you have enough close friends or relatives?" (coded 0 = no, .5 = neutral, 1 = yes). We standardize the three questions and take the average, so that the social support index is scored from 0 to 1. These items capture both the quantity and quality of social support, as respondents are asked about numbers of *close* relatives and friends—people one can really talk to and call on—and about perceived adequacy of this number.

Measuring health lifestyle. *Exercise* is measured by a seven-item index. Respondents were asked, "Please tell me how often you participate in these activities. How often do you (1) go swimming in the summer, (2) take long walks, (3) work on a physically active hobby such as dancing or gardening, (4) go jogging or running, (5) ride a bicycle, (6) do calisthenics or physical exercise, or (7) participate in any other active sports I haven't already mentioned?" (coded 1 = never, 2 = rarely, 3 = sometimes, 4 = often). The exercise index is scored as the mean response to the seven activities; high scores indicate high levels of exercise.

Smoking is coded in three categories (0 = never smoked, 1 = quit, 2 = current smoker).

Drinking is composed of a series of dummy variables: abstain from drinking, rare drinking, moderate drinking, and heavy drinking. Quantity/frequency drinking scores were computed by multiplying the number of days per week on which the person reports drinking by the number of drinks reported for the average day, and then categorized since the effect of drinking on health is probably nonlinear. The drinking measure is detailed in Appendix B.

Health check-ups are measured by the response to the question: "Some people get a general physical examination once in a while, even though they are feeling well and have not been sick. When was the last time you had a general physical examination when you were not sick?" (coded 0 = never, 1 = 5 or more years ago, 2 = 2 to 4 years ago, 3 = 1 to 2 years ago, 4 = less than 1 year ago). High scores indicate more recent check-ups.

ANALYSIS

We propose that work and economic conditions, social-psychological resources, and health lifestyle are the links between education and health. To establish support for our model, education must be positively associated with health, and with work and economic conditions, social-psychological resources, and health lifestyle. We must also find that our three sets of explanatory variables are positively associated with health, and that they mediate or explain the observed association between education and health.

We first examine the mean levels of work and economic conditions, social-psychologi-

cal resources, and health lifestyle among respondents with less than a high school degree, a high school degree to some college, and a college degree or more. (Education is categorized for these analyses only.)

Next, using multiple regression analysis, we examine the effect of education on health and the explanations for this association, cross-sectionally and over time. Equation 1 shows the total causal effect of education on health, adjusting for the sociodemographic precursors of sex, race, age and marital status. Equation 2 adds the first set of explanatory variables—work and economic conditions—including employment status, household income, economic hardship, and work fulfillment. Equation 3 adds the variables measuring social-psychological resources—sense of control and social support. Equation 4 adds health lifestyle measures—exercise, smoking, drinking, and health check-ups. The three sets of explanatory variables are added in an order that represents a proposed sequence in which work and economic conditions precede social-psychological resources, which precede health lifestyle. Although there may be reciprocal effects, longitudinal research shows that work and economic status affect sense of control and social support (Pearlin et al. 1981; Wheaton 1980), which in turn affect health behavior (Seeman and Seeman 1983). In each step of our analysis, we examine the effects of the explanatory variables on health, and whether the association between education and health is reduced with the addition of these variables, thus partially explaining[4] the association. We test our model using cross-sectional analyses with two data sets,[5] and using longitudinal analysis that examines changes in health over time. In the latter, change in health status is the dependent variable:

$$(Health_{1980} - Health_{1979}) = b_0 + b_1\, Education + b_2\, Health_{1979} + \sum_{i=3}^{k} b_i X_{i\,1979} + u,$$

where change in health status over time is a function of education and the three sets of explanatory variables; sociodemographic characteristics and *health at time 1* are controlled. In this way, we address the causal order issue of whether education and the explanatory variables affect health, or whether health simply shapes educational attainment, employment, and so on.[6]

RESULTS

The Association between Education and Work and Economic Conditions, Social-Psychological Resources, and Health Lifestyle

Tables 1 and 2 show that in both samples work and economic conditions are significantly better among the college educated than among those with a high school degree or less. The college educated are significantly more likely to be employed full-time than are people with only a high school degree, followed by those who did not finish high school. In contrast, people who have not finished high school are the least likely to be employed. (People with a high school degree are more likely to work part-time than are people with a college degree or with no high

[4] We use the word "explain" in the statistical sense (Davis 1985).

[5] The replications are almost, but not exactly, the same. The Health Practices sample (HP) includes measures of drinking behavior and check-ups, whereas the Work, Family, and Well-Being sample (WFW) does not; WFW includes a measure of work fulfillment whereas HP does not. Sense of control is specific to health in HP and general in WFW. Finally, WFW has no upper age limit, whereas HP includes only persons under age 65.

[6] The model in which change in health (ΔY) is the dependent variable is equivalent to one in which health at time 2 (Y_2) is the dependent variable, when health at time 1 (Y_1) is controlled. (X_1 is an independent variable such as education at time 1.) Only the R^2s and the coefficients associated with health at time 1 ($b_1 Y_1$) differ in the two models, and the bs are linear transformations:

$$\begin{aligned} \Delta Y &= Y_2 - Y_1 \\ \Delta Y &= b_0 + b_1 Y_1 + b_2 X_1 + U_{\Delta Y} \\ Y_2 - Y_1 &= b_0 + b_1 Y_1 + b_2 X_1 + U_{\Delta Y} \\ Y_2 &= b_0 + Y_1 + b_1 Y_1 + b_2 X_1 + U_{\Delta Y} \\ Y_2 &= b_0 + (b_1 + 1) Y_1 + b_2 X_1 + U_{\Delta Y}. \end{aligned}$$

In sum, b_1 when ΔY is dependent equals $b_1 + 1$ when Y_2 is dependent. The R^2s in the four equations in Table 7 are higher when health time 2 is dependent: .488, .498, .503, and .507.

school degree.) The college educated are least likely to be unable to work because of disability. Household incomes are highest among the college educated in both samples. In the WFW sample, the college educated had an average household income of $50,290, compared to $36,507 among those with a high school degree, and $25,439 among those who did not finish high school (See Table 1). Economic hardship is highest among respondents who did not finish high school, followed by those with a high school degree, and lowest among those with a college degree or more. In the WFW sample, the college educated have significantly higher levels of work fulfillment than do people with a high school degree, followed by those who did not finish high school.

As education level increases, the sense of control over one's life and one's health increases (sense of control is measured as control over one's life in general in the WFW sample and over one's health in particular in HP sample), as does the level of social support. In both samples, the college educated are significantly more likely to exercise and significantly less likely to smoke. Table 2 also shows that the college educated are the least likely of the three educational groups to abstain from drinking or to drink heavily; they are the most likely to drink moderately. The likelihood of getting health check-ups increases with educational attainment.

Table 1. Means for Variables Measuring Health, Work and Economic Conditions, Social-Psychological Resources, and Health Lifestyle at Three Levels of Education: Work, Family, and Well-Being Sample, 1990

Variable	Less Than High School Degree	High School Degree to Some College	College Degree or More
Health			
Self-reported health*	3.591 (1.073)	4.193 (.851)	4.430 (.711)
Physical functioning*	1.599 (.478)	1.847 (.261)	1.905 (.188)
Work and Economic Conditions			
Employed full-time*	.305 (.461)	.511 (.500)	.684 (.465)
Employed part-time*	.063 (.244)	.119 (.323)	.101 (.302)
Not employed*	.539 (.499)	.350 (.477)	.211 (.408)
Unable to work*	.093 (.291)	.021 (.142)	.004 (.064)
Household income[a]*	25.439 (17.761)	36.507 (23.362)	50.290 (31.821)
Economic hardship*	.616 (.805)	.491 (.704)	.250 (.477)
Work fulfillment*	.784 (.780)	.937 (.747)	1.167 (.700)
Social-Psychological Resources			
Sense of control*	.334 (.437)	.664 (.482)	.840 (.475)
Social support*	.922 (.812)	1.116 (.769)	1.224 (.768)
Health Lifestyle			
Exercise*	2.136 (1.788)	2.343 (1.806)	2.536 (1.748)
Smoking*	.915 (.880)	.788 (.842)	.580 (.743)

* Education categories significantly different at $p < .05$ (two-tailed tests).

[a] Coded in thousands of dollars per year.

Note: N = 2,031; standard deviations in parentheses.

Explaining the Association between Education and Health: Cross-Sectional Analysis

Self-reported health. In both samples, the college educated report significantly better health than do those with a high school degree or less (see Tables 1 and 2 for unadjusted means). Equation 1 in Tables 3 and 4 shows that the well educated report significantly better health than the poorly educated, controlling for sex, minority status, age, and marital status. (In addition, people who are White, male, and married report better health than non-Whites, women, and the unmarried, although the effect of sex is significant only in the WFW sample; and older people report worse health than younger.)

Work and economic conditions are added in equation 2. People who are employed report better health than the nonemployed. In both samples the positive effect of full-time employment is greater than that of part-time employment, and in the WFW sample, part-time employment is significant only at $p < .10$. In both samples, we adjust for inability to work because of poor health or disability.

Table 2. Means for Variables Measuring Health, Work and Economic Conditions, Social-Psychological Resources, and Health Lifestyle at Three Levels of Education: Health Practices Sample, 1979

Variable	Less Than High School Degree	High School Degree to Some College	College Degree or More
Health			
Self-reported health*	3.344 (1.153)	4.054 (.904)	4.340 (.729)
Physical functioning*	1.731 (.477)	1.898 (.272)	1.955 (.166)
Work and Economic Conditions			
Employed full-time*	.458 (.499)	.599 (.490)	.757 (.431)
Employed part-time*	.073 (.261)	.106 (.308)	.063 (.254)
Not employed*	.395 (.489)	.275 (.447)	.167 (.373)
Unable to work*	.075 (.263)	.019 (.134)	.007 (.084)
Household income*	12.672 (7.860)	17.200 (8.138)	21.345 (8.703)
Economic hardship*	.361 (.412)	.244 (.356)	.179 (.318)
Social-Psychological Resources			
Sense of control*	3.971 (1.163)	4.303 (.962)	4.467 (.825)
Social support*	−.074 (.723)	.020 (.683)	.084 (.659)
Health Lifestyle			
Exercise*	2.081 (.643)	2.466 (.616)	2.665 (.565)
Smoking*	1.121 (.893)	.906 (.890)	.789 (.841)
Abstain from drinking*	.432 (.499)	.262 (.440)	.139 (.346)
Rare drinking*	.223 (.416)	.280 (.449)	.222 (.416)
Moderate drinking*	.286 (.452)	.418 (.493)	.618 (.486)
Heavy drinking*	.037 (.188)	.024 (.152)	.011 (.103)
Check-ups*	2.719 (1.354)	2.888 (1.274)	2.957 (1.174)

*Education categories significantly different at $p < .05$ (two-tailed tests).

Note: N = 3,025; standard deviations in parentheses.

Thus, the positive effect of employment on health is not due to the fact that some people in poor health do not work (a selection effect). Economic hardship has a significant negative effect on self-reported health in both samples. High household income is significantly associated with good health and low income with poor health in the HP sample, where household income affects health over and above economic hardship. In the WFW sample, economic hardship explains the effect of income, reducing its significance to .08. Part but not all of the reason income improves health is that it decreases economic strain: People with high incomes have little if any trouble paying for food, clothing, medical care, and monthly bills. Work fulfillment, a variable available only in the WFW sample, is significantly positively associated with health.

Social-psychological resources are added in equation 3 of Tables 3 and 4. A high sense of personal control over one's life in general (Table 3) and one's health in particular (Table 4) are significantly associated with good self-reported health. Social support is also positively associated with health, but is statistically significant only in the HP sample. Education is positively associated with a sense of personal control over one's life and one's health, and with high levels of social support, which in turn are positively associated with health. These associations help explain some of the association between education and health.

Health lifestyle is added in equation 4 of Tables 3 and 4. In both samples, exercise has a significant positive effect on health, and smoking a significant negative effect. The HP sample also has information on health check-ups and drinking behavior. People who abstain from drinking report significantly worse health than those who drink moderately (the omitted category in the regression analysis). Compared to moderate drinking, rare and heavy drinking are also associated with worse health, but not significantly so. Getting check-ups does not significantly affect health. Thus, we find that smoking and exercise are more important determinants of self-reported health and explain more of education's effect on health than do drinking or getting check-ups. Furthermore, abstaining from drinking does not improve

Table 3. Self-Reported Health Regressed on Education, Controlling for Sociodemographic Characteristics (Equation 1), Work and Economic Conditions (Equation 2), Social-Psychological Resources (Equation 3), and Health Lifestyle (Equation 4): Work, Family, and Well-Being Sample, 1990

	Equation 1		Equation 2		Equation 3		Equation 4	
Variable	b	Beta	b	Beta	b	Beta	b	Beta
Education	.076*** (.007)	.220	.041*** (.007)	.121	.036*** (.008)	.105	.031*** (.008)	.091
Sociodemographic Characteristics								
Sex (male = 1)	.114** (.038)	.062	.051 (.038)	.028	.054* (.038)	.029	.045 (.038)	.025
Race (White = 1)	.239*** (.056)	.089	.168** (.054)	.062	.156** (.054)	.058	.180*** (.054)	.069
Age (in years)	−.013*** (.001)	−.247	−.012*** (.001)	−.226	−.011*** (.001)	−.213	−.011*** (.001)	−.205
Marital status (married = 1)	.105** (.040)	.058	.043 (.037)	.024	.042 (.037)	.023	.055 (.037)	.030
Work and Economic Conditions								
Employed full-time[a]	—		.174*** (.044)	.098	.172*** (.044)	.097	.191*** (.044)	.107
Employed part-time[a]	—		.109 (.064)	.038	.108 (.064)	.038	.112 (.063)	.039
Unable to work[a]	—		−.835*** (.114)	−.150	−.827*** (.114)	−.149	−.779*** (.113)	−.140
Household income	—		.001 (.001)	.040	.001 (.001)	.033	.001 (.001)	.031
Economic hardship	—		−.172*** (.028)	−.133	−.169*** (.028)	−.130	−.158*** (.028)	−.121
Work fulfillment	—		.158*** (.024)	.134	.145*** (.025)	.122	.138*** (.024)	.116
Social-Psychological Resources								
Sense of control	—		—		.131*** (.038)	.074	.124** (.038)	.069
Social support	—		—		.015 (.024)	.013	.012 (.023)	.011
Health Lifestyle								
Exercise	—		—		—		.043*** (.010)	.088
Smoking	—		—		—		−.082*** (.021)	−.077
Constant	3.413		3.729		3.699		3.681	
R^2	.152		.234		.239		.252	

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

[a] Compared to not employed (for reasons other than health).

Note: N = 2,031; b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

Table 4. Self-Reported Health Regressed on Education, Controlling for Sociodemographic Characteristics (Equation 1), Work and Economic Conditions (Equation 2), Social-Psychological Resources (Equation 3), and Health Lifestyle (Equation 4): Health Practices Sample, 1979

	Equation 1		Equation 2		Equation 3		Equation 4	
Variable	b	Beta	b	Beta	b	Beta	b	Beta
Education	.122*** (.007)	.312	.080*** (.007)	.204	.070*** (.007)	.179	.054*** (.007)	.139
Sociodemographic Characteristics								
Sex (male = 1)	.014 (.035)	.007	−.075* (.035)	−.037	−.062 (.034)	−.030	−.104** (.035)	−.051
Race (White = 1)	.281*** (.049)	.102	.141** (.045)	.051	.122** (.044)	.044	.102* (.044)	.037
Age (in years)	−.011*** (.001)	−.148	−.011*** (.001)	−.140	−.009*** (.001)	−.121	−.003* (.001)	−.040
Marital status (married = 1)	.145*** (.037)	.070	.021 (.037)	.010	.025 (.035)	.012	.050 (.035)	.024
Work and Economic Conditions								
Employed full-time[a]	—		.219*** (.040)	.108	.221*** (.039)	.109	.228*** (.038)	.113
Employed part-time[a]	—		.213*** (.059)	.062	.184** (.058)	.053	.156** (.057)	.045
Unable to work[a]	—		−1.254*** (.099)	−.210	−1.131*** (.097)	−.190	−.981*** (.096)	−.164
Household income	—		.013*** (.002)	.114	.012*** (.002)	.102	.008*** (.002)	.073
Economic hardship	—		−.411*** (.046)	−.152	−.358*** (.046)	−.132	−.349*** (.045)	−.129
Social-Psychological Resources								
Sense of control	—		—		.176*** (.016)	.178	.151*** (.016)	.153
Social support	—		—		.094*** (.023)	.065	.067** (.022)	.047
Health Lifestyle								
Exercise	—		—		—		.295*** (.028)	.191
Smoking	—		—		—		−.046** (.018)	−.041
Abstain from drinking[b]	—		—		—		−.164*** (.041)	−.074
Rare drinking[b]	—		—		—		−.026 (.038)	−.011
Heavy drinking[b]	—		—		—		−.056 (.100)	−.009
Check-ups	—		—		—		−.014 (.012)	−.018
Constant	2.532		3.040		2.371		1.916	
R^2	.159		.271		.306		.339	

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests).

[a] Compared to not employed (for reasons other than health).

[b] Compared to moderate drinking.

Note: N = 3,025; b = unstandardized regression coefficient with standard errors in parenthesis; Beta = standardized regression coefficient.

self-reported health. Consistent with recent evidence on heart disease, stroke, and high blood pressure, we find that people who abstain from drinking report *worse* health than those who drink moderately. The well educated are more likely to exercise, less likely to smoke, and less likely to abstain from drinking, which explains some of the effect of education on self-reported health. Higher levels of preventive medical care—measured as health check-ups—among the well educated do not explain any of the association.

All together, work and economic conditions, social-psychological resources, and health lifestyle explain 55 percent of the cross-sectional association between education and health in the HP sample ([.122 – .054]/.122 = .55) and 59 percent of the association in the WFW sample ([.076 – .031]/.076 =.59). Further, F-tests on the increments to R^2 for each additional block of explanatory variables are significant in both samples.

Physical functioning. In both samples, the college educated report significantly better physical functioning than those with a high school degree or less (see Tables 1 and 2 for unadjusted means). Equation 1 in Tables 5 and 6 shows that the well educated report significantly better physical functioning than the poorly educated, controlling for sex, minority status, age, and marital status. (In addition, people who are married, young, male and White report better physical functioning than unmarried people, older people, women, and non-Whites, although race is significant only in the HP sample.) The effect of education on physical functioning is as large or larger than its effect on self-reported health, and more of the association is explained in both samples (see Tables 4, 5 and 6).[7]

Work and economic conditions are added in equation 2 of Tables 5 and 6. In both samples, part-time and full-time employment are better for physical functioning than not being employed, even controlling for being out of the work force due to disability or poor health. Economic hardship is associated with poor physical functioning, although the effect of household income is not significant in either sample, adjusting for economic hardship. Work fulfillment (WFW sample, Table 5) is associated with good physical functioning.

Social-psychological resources are added in equation 3 of Tables 5 and 6. The sense of control over one's life and one's future health are both significantly associated with good physical functioning, whereas social support is not significant in either sample.

Health lifestyle, added in equation 4, has a much smaller effect on physical functioning than it does on self-reported health. Only exercise has significant effects in either sample, and the causal order here is problematic because a person with physical disabilities may not be able to exercise. Health lifestyle explains much less of the association between education and physical functioning than between education and self-reported health.

All together, work and economic conditions, social-psychological resources, and health lifestyle explain 71 percent of the association between education and physical functioning in the HP sample ([.024 – .007]/.024 = .71) and 46 percent in the WFW sample ([.026 – .014]/.026 = .46. Further, F-tests on the increments to R^2 for each additional block of explanatory variables are significant in both samples.[8]

[7] The question of whether having a college degree has an effect on health over and above years of schooling per se can be examined in the WFW sample. Is the credential of a college degree as important or more important to health than years of schooling completed? We added a dummy variable for having a college degree to the first equations in Tables 3 and 5. Having a college degree did not have an independent significant effect on self-reported health (p = .44) or on physical functioning (p = .27), *over and above* years of schooling completed.

[8] Before turning to longitudinal analyses, we ran three final cross-sectional analyses. We transformed the dependent variables to decrease non-normality; we tested interaction terms to determine whether the effects of education on health are conditional on other variables; and we examined the effects of parental education on respondent's health.

First, the distributions of self-reported health and physical functioning are skewed. Skewness, or non-normality of the dependent variable, can produce heteroskedasticity. The consequence of non-normal dependent variables is that heteroskedasticity produces the potential for inflated standard errors of the estimates, making the effects appear less significant than they really are. (Estimates are not biased in large samples.) We corrected for non-normality by raising the value of the dependent variables to a power. To deter-

Table 5. Physical Functioning Regressed on Education, Controlling for Sociodemographic Characteristics (Equation 1), Work and Economic Conditions (Equation 2), Social-Psychological Resources (Equation 3), and Health Lifestyle (Equation 4): Work, Family, and Well-Being Sample, 1990

	Equation 1		Equation 2		Equation 3		Equation 4	
Variable	b	Beta	b	Beta	b	Beta	b	Beta
Education	.026***	.222	.015***	.134	.014***	.125	.014***	.120
	(.002)		(.002)		(.002)		(.002)	
Sociodemographic Characteristics								
Sex (male = 1)	.032**	.052	.019	.031	.019	.030	.011	.018
	(.012)		(.011)		(.012)		(.012)	
Race (White = 1)	.018	.020	−.005	−.006	−.007	−.008	−.005	−.005
	(.018)		(.016)		(.017)		(.017)	
Age (in years)	−.006***	−.358	−.006***	−.325	−.006***	−.320	−.005***	−.311
	(.000)		(.000)		(.000)		(.000)	
Marital status (married = 1)	.061***	.100	.045***	.073	.045***	.075	.048***	.078
	(.012)		(.012)		(.012)		(.017)	
Work and Economic Conditions								
Employed full-time[a]	—		.058***	.097	.057***	.095	.062***	.103
			(.014)		(.014)		(.014)	
Employed part-time[a]	—		.060**	.062	.060**	.062	.063**	.065
			(.020)		(.020)		(.020)	
Unable to work[a]	—		−.488***	−.260	−.486***	−.259	−.477***	−.254
			(.036)		(.036)		(.036)	
Household income	—		.000	.002	.000	.002	.000	.003
			(.000)		(.000)		(.000)	
Economic hardship	—		−.044***	−.101	−.044***	−.100	−.043***	−.098
			(.009)		(.008)		(.009)	
Work fulfillment	—		.034***	.085	.033***	.082	.030***	.074
			(.008)		(.008)		(.008)	
Social-Psychological Resources								
Sense of control	—		—		.027***	.045	.021	.035
					(.012)		(.012)	
Social support	—		—		.004	.011	.004	.011
					(.007)		(.007)	
Health Lifestyle								
Exercise	—		—		—		.017***	.099
							(.003)	
Smoking	—		—		—		−.000	−.000
							(.007)	
Constant	1.700		1.802		1.803		1.767	
R^2	.226		.334		.336		.345	

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

[a] Compared to not employed (for reasons other than health).

Note: N = 2,031; b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

Table 6. Physical Functioning Regressed on Education, Controlling for Sociodemographic Characteristics (Equation 1), Work and Economic Conditions (Equation 2), Social-Psychological Resources (Equation 3), and Health Lifestyle (Equation 4): Health Practices Sample, 1979

	Equation 1		Equation 2		Equation 3		Equation 4	
Variable	b	Beta	b	Beta	b	Beta	b	Beta
Education	.024*** (.002)	.189	.011*** (.002)	.086	.009*** (.002)	.073	.007** (.002)	.053
Sociodemographic Characteristics								
Sex (male = 1)	.050*** (.011)	.076	.032** (.011)	.049	.034** (.011)	.052	.025* (.011)	.037
Race (White = 1)	.059*** (.016)	.062	.005 (.014)	.005	.003 (.014)	.003	.004 (.014)	.004
Age (in years)	−.005*** (.000)	−.218	−.005*** (.000)	−.191	−.005*** (.000)	−.180	−.003*** (.000)	−.119
Marital status (married = 1)	.044*** (.012)	.065	.009 (.011)	.014	.011 (.011)	.015	.014 (.011)	.021
Work and Economic Conditions								
Employed full-time[a]	—		.057*** (.012)	.086	.057*** (.012)	.087	.059*** (.012)	.089
Employed part-time[a]	—		.070*** (.019)	.063	.066** (.019)	.059	.060** (.018)	.054
Unable to work[a]	—		−.750*** (.031)	−.387	−.729*** (.031)	−.377	−.693*** (.031)	−.358
Household income	—		.001 (.001)	.024	.000 (.000)	.017	.000 (.000)	.000
Economic hardship	—		−.155*** (.015)	−.176	−.147*** (.015)	−.168	−.148*** (.014)	−.168
Social-Psychological Resources								
Sense of control	—		—		.030*** (.005)	.094	.024*** (.005)	.075
Social support	—		—		.011 (.007)	.024	.004 (.007)	.008
Health Lifestyle								
Exercise	—		—		—		.079*** (.009)	.158
Smoking	—		—		—		.000 (.006)	.002
Abstain from drinking[b]	—		—		—		−.008 (.013)	−.011
Rare drinking[b]	—		—		—		.019 (.012)	.025
Heavy drinking[b]	—		—		—		.036 (.032)	.017
Check-ups	—		—		—		−.005 (.004)	−.019
Constant	1.686		1.907		1.790		1.623	
R^2	.115		.324		.333		.351	

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

[a] Compared to not employed (for reasons other than health).

[b] Compared to moderate drinking.

Note: N = 3,025; b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

Explaining the Association between Education and Health: Longitudinal Analysis

Self-reported health. Table 7 shows the effect of education on the change in self-reported health over one year, and the explanations for the association, controlling for health at time 1. The results are from the HP sample; time 1 is 1979 and time 2 is 1980. On average, the change in health over one year is negative. Thus, positive coefficients "slow" the decline in health between 1979 and 1980. Equation 1 reveals a large positive effect of education on change in health, controlling for health at time 1. In addition age accelerates the decline in health, and the better one's self-reported health is at time 1, the more negative it becomes, which probably indicates a ceiling effect.

Equations 2 through 4 add explanatory variables. Work and economic conditions are added in equation 2. Full-time employment and high household income significantly slow the decline in health over the one-year period, whereas part-time employment has no significant effect. Economic hardship significantly accelerates the decline. Equation 3 adds the sense of control over one's health and social support. A high sense of control over one's future health significantly slows the decline in self-reported health over time. Equation 4 adds health lifestyle. Exercise significantly slows the negative change in self-reported over time. Smoking has little effect over a one-year period. Its effects are likely to be cumulative over a life time. Drinking behavior does, however, affect the change in health. Abstinence somewhat accelerates the decline in health over one year (p = .07), whereas rare drinking slows the decline. All together, work and economic conditions, social-psychological resources, and health lifestyle explain 43 percent of the total effect of education on the change in health ([.037 −.021]/.037 = .43). A significant direct effect of education on the change in health over time remains, however, indi-

mine what this power should be, we calculated the interquartile range (measure of dispersion) and the median (measure of central tendency) for both dependent variables at each level of education, and then regressed the log of the interquartile range on the log of the median. This yielded a coefficient (b) that we used to correct for heteroskedasticity (y to the N power, where $N = 1 - b$). In the WFW sample, N was 1.52 for self-reported health and 2.25 for physical functioning. Using these powers we created two new dependent variables, self-reported health to the 1.52 power and physical functioning to the 2.25 power. These transformations decreased heteroskedasticity, so we reran the regressions for the WFW sample using the transformed dependent variables. In no case were the substantive conclusions different. Although some significance levels changed slightly, they did not change from the conventional levels reported for untransformed variables.

Second, education's positive effect on health may be conditional on other characteristics. We tested interactions of education with all sociodemographic and work/economic characteristics. Two interactions with education—age and household income—were consistent in sign and largely significant across all analyses. The positive effect of education on physical functioning increases with age, although the positive interaction of education with age only approaches significance ($p <$ .10) in the self-reported health analyses. The positive effect of education on both health outcomes decreases significantly as household income increases.

Third, educational attainment is structured by parental socioeconomic status. The WFW sample measures parents' education. We re-estimated a new equation 1 (Tables 3 and 5) that included parental education measured as the average of both parents' years of schooling completed. Next we added respondent's education, controlling for age, sex, race, and marital status. We found that parents' education positively affects respondents' self-reported health and physical functioning largely because it shapes a respondent's educational opportunities. The bivariate association between parental education and respondent's self-reported health is highly significant (b = .060, beta = .194, t = 8.872, p = .000). When respondent's education and sociodemographic characteristics are added to the equation the association between parental education and health becomes nonsignificant at the $p < .05$ level, although it approaches significance (p = .09). When respondent's work and economic conditions are added, the effect-of parental status is nonsignificant (p = .19). The bivariate association between parental education and respondent's physical functioning is also highly significant (b = .021, beta = .202, t = 9.268, p = .000). When respondent's education and sociodemographic characteristics are added to the equation, the positive association between parents' education and physical functioning becomes nonsignificant (p = .611).

Table 7. Change in Self-Reported Health between 1979 and 1980 Regressed on Education, Controlling for Health in 1979 and Sociodemographic Characteristics (Equation 1), Work and Economic Conditions (Equation 2), Social-Psychological Resources (Equation 3), and Health Lifestyle (Equation 4): Health Practices Sample, 1979–1980

	Equation 1		Equation 2		Equation 3		Equation 4	
Variable	b	Beta	b	Beta	b	Beta	b	Beta
Education	.037*** (.006)	.125	.027*** (.006)	.090	.025*** (.006)	.082	.021*** (.006)	.071
Sociodemographic Characteristics and Prior Health								
Health in 1979	−.348*** (.016)	−.454	−.395*** (.016)	−.515	−.413*** (.017)	−.539	−.429*** (.017)	−.559
Sex (male = 1)	.020 (.030)	.013	−.036 (.031)	−.023	−.032 (.032)	−.020	−.040 (.033)	−.026
Race (White = 1)	.034 (.041)	.016	−.003 (.031)	−.002	.0004 (.040)	.0002	−.008 (.040)	−.004
Age (in years)	−.004** (.001)	−.060	−.004*** (.001)	−.069	−.004** (.001)	−.060	−.002 (.001)	−.029
Marital status (married = 1)	.042 (.031)	.026	.011 (.032)	.007	.017 (.032)	.011	.023 (.032)	.015
Work and Economic Conditions								
Employed full-time[a]	—		.139*** (.035)	.090	.144*** (.035)	.093	.145*** (.035)	.094
Employed part-time[a]	—		.077 (.053)	.029	.071 (.053)	.027	.056 (.053)	.021
Unable to work[a]	—		−.245** (.091)	−.054	−.216* (.090)	−.047	−.179* (.090)	−.039
Household income	—		.005* (.002)	.055	.004* (.002)	.051	.004 (.002)	.042
Economic hardship	—		−.191*** (.042)	−.092	−.187*** (.042)	−.090	−.192*** (.042)	−.092
Social-Psychological Resources								
Sense of control	—		—		.081*** (.015)	.107	.076*** (.015)	.100
Social support	—		—		−.005 (.021)	−.005	−.011 (.021)	−.010
Health Lifestyle								
Exercise	—		—		—		.088*** (.026)	.075
Smoking	—		—		—		−.007 (.016)	−.008
Abstain from drinking[b]	—		—		—		−.071 (.038)	−.041
Rare drinking[b]	—		—		—		.072* (.036)	.041
Heavy drinking[b]	—		—		—		−.016 (.093)	−.003
Check-ups	—		—		—		−.012 (.011)	−.020
Constant	.948		1.239		.969		.875	
R^2	.175		.198		.208		.217	

*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

[a] Compared to not employed (for reasons other than health).

[b] Compared to moderate drinking.

Note: N = 2,436; b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

cating that even after adjusting for explanatory variables, a higher level of education significantly slows the decline in self-reported health over one year.

One year is a short period of time; self-reported health does not decline much in one year (–.036 on a 5-point scale with a mean of 3.9 and standard deviation of .992 at time 1). It is somewhat surprising that we can predict this small change in health at all. The fact that education, work and economic conditions, sense of control, and health lifestyle significantly affect the change in health in over a year's time indicates the strength and pervasiveness of education's effect on health.

Physical functioning. Last, using the HP sample, we predict the change in physical functioning between 1979 and 1980 from education, sociodemographics, and physical functioning in 1979. Level of physical function changes even less in one year than does self-reported health (–.004 on a scale of 0 to 2). Given the small variance in this dependent variable, we do not report our results in a table. Nonetheless, education does have a significant positive effect on change in physical functioning over one year (b = .006, s.e. = .002, Beta = .049, p = .004). Education significantly slows the decline in physical functioning over time.

SUMMARY AND CONCLUSION

In two national samples, education is strongly and positively associated with two measures of health—self-reported health and physical functioning—both cross-sectionally and over time. For both health measures in both samples, a large part of the association is explained by our explanatory variables, but a significant direct effect of education remains: Adjusting for work and economic conditions, social-psychological resources, and health lifestyle, education remains significantly associated with good health. This unexplained effect could be due to unreliability in our explanatory variables, to other factors not included in our model, or to direct physiological consequences of education. Education teaches a person to use his or her mind: Learning, thinking, reasoning, solving problems, and so on are mental exercises that may keep the central nervous system in shape the same way that physical exercise keeps the body in shape. On the other hand, some of the effect attributed to education's impact on knowledge, learning, and problem-solving may have less to do with skills learned in school than the consequences of educational attainment for work. The jobs available to those with little schooling are more likely to be stressful, dangerous, and "dead-end" (Leigh 1983).[9]

Education improves health indirectly through work and economic conditions, social-psychological resources, and health lifestyle. The well educated are more likely than the poorly educated to be employed. Education gives people greater access to full-time rather than part-time work. It provides more of an opportunity for a fulfilling and enjoyable worklife and provides enough income so that economic hardship is low. Education boosts the sense of control, shaping the perception that one's life and one's health result from one's own actions and decisions. Well educated people report more supportive relationships. And finally, the well educated have a more positive health lifestyle: They are more likely to exercise, less likely to smoke, more likely to drink moderately rather than abstain or drink heavily, and are more likely to get annual health check-ups.

Compared to not working for pay, full-time employment, and, to a much lesser extent, part-time employment, are associated with good health. Fulfilling work and low levels

[9] A narrow stratification approach to inequality looks at job status or rank; occupation-based social class; whether the job is in the core or periphery; has internal labor markets; exposes workers to dangerous conditions, and so on. We did not take this approach because the most disadvantaged are not included in these theories or research. People who have been fired or laid off, women engaged in unpaid domestic labor, the nonemployed elderly, and so on, are likely the most disadvantaged. Given our focus on the effect of social inequality on health, we did not want to exclude people from our analyses who were not in the paid economy. Furthermore, women are overrepresented in the groups ignored by mainstream stratification theory and research. Almost all homemakers are women; because women live longer than men, the majority of nonemployed elderly are women; and as paid workers with relatively short tenure and low-level jobs, women are among the first laid off or fired in economic downturns.

of economic hardship are associated with good health. The sense of personal control and, to a smaller degree, social support are associated with good health. Exercising, not smoking, and drinking some alcohol rather than abstaining are associated with good health. Of all the hypothesized mediating variables, only health check-ups are not significantly associated with health in any of the analyses.

Although well educated people are more likely to get check-ups than people with less education, having regular check-ups cannot explain any of the association between education and health because check-ups do not significantly affect health. The goal of *primary* prevention is to *prevent the onset of disease* by reducing risks (through exercise, not smoking, or drinking in moderation). Annual check-ups are secondary prevention. The goal of *secondary* prevention is to *catch disease early* to limit the consequences. Almost all prevention in our medical care system is secondary, not primary, despite better evidence for the health benefits of primary prevention. In fact, there is little evidence that check-ups protect *adults'* health (U.S. Preventive Services Task Force 1989). The rationale behind annual physical exams makes four potentially false assumptions: (1) check-ups catch disease early, (2) detecting disease early makes a difference in outcome, (3) check-ups do no harm, and (4) the people who might benefit from check-ups get them (Canadian Task Force on the Periodic Health Examination 1979, 1988). First, annual physical exams are not targeted to an individual's risk, so they are unlikely to find undetected disease. Second, early detection is not useful unless the treatment that follows is effective in slowing the course of illness, or ideally in curing it; this is rare for many chronic diseases. Third, screening that is not targeted at high-risk groups produces a certain percentage of false positives that can lead to dangerous and unnecessary treatments for nonexistent diseases, distress caused by the false diagnosis, and risks from the actual screening tests, which can expose people to risk of infection from invasive procedures, small amounts of radiation, and so on (Bailar and Smith 1986; Canadian Task Force 1979). Fourth, the people who need check-ups the least are the most likely to get them, and vice versa. The well educated need preventive medical care least because they are at the lowest risk of illness: They are less likely to experience stress and economic hardship from unemployment or poverty, the resulting sense of fatalism and powerlessness, or the higher probability of smoking, heavy drinking, and of leading sedentary lives.

The hypothesized links between education and health are largely supported in our study, but are the relationships causal? We address causal order issues in three ways: (1) outside evidence on established life course sequences, (2) controls for selection in cross-sectional data analyses, and (3) longitudinal data which we use to examine the change in health over time, controlling for health at time 1. First, the completion of formal schooling typically occurs by a respondent's late twenties. Although some people do return to school later in life, it is unlikely that most of the relationship between education and health is due to reverse causal order, in which people in poor health do not complete school (Davis 1985). It is more likely that education shapes a person's resources and opportunities, and thus shapes his or her health. However, some work and economic conditions, social psychological resources and health behaviors could be shaped by prior health.[10] Thus, second, in our cross-sectional data analysis we adjusted for the inability to work because of poor health. This controls for selection out of the work force due to poor health. Significant associations between health and employment (and the consequences of employment for income and economic strain) are thus likely to result from the positive effects of employment on health. Nonetheless, some reciprocal relationships are possible. For example, the

[10] Both economic hardship measures include difficulty paying for medical care, which could be a consequence, rather than a cause, of poor health in cross-sectional analyses. We deleted this item from the hardship measures in both samples and reran all analyses. We compared the effects in equation 4 in Tables 3 through 7. The exclusion of difficulty paying for medical care did not change substantive conclusions. Economic hardship remained significantly negatively associated with health ($p < .001$ in all cases), although the effects were smaller.

sense of personal control likely shapes a person's health, which in turn affects the sense of control. We don't claim that reciprocal effects such as these do not exist, but we want to ensure that the proposed causal effects do exist. Therefore, third, we examine the change in health over time. If we find that a person's sense of control at time 1 significantly affects the change in his or her health between times 1 and 2 controlling for health at time 1, we know that sense of control affects health, and not simply that health affects the sense of control. This is the case for all variables examined.

The conclusions of our longitudinal analyses are substantively the same as those for our cross-sectional analyses, although there are a few differences. First, part-time employment, which is significant in three of the four cross-sectional analyses, is nonsignificant over time. Full-time employment appears to be best for health, while the benefits of part-time employment are smaller. Second, as in three of the four cross-sectional analyses, the effect of social support is not significant over time. The sense of control is a greater health-related social-psychological resource than is social support in these analyses. Third, in the cross-sectional analysis, rare drinking is not significantly different from moderate drinking in its effect on health. Over time, however, rare drinking is significantly better for health than moderate drinking. Nonetheless, in both analyses, abstaining from drinking is worse for health than rare to moderate drinking. Fourth, smoking does not significantly worsen health in one year's time, although cross-sectional analyses show very significant negative effects of smoking on self-reported health. The cross-sectional analyses capture the cumulative effect of a life time's smoking on health. Unfortunately the HP panel survey followed individuals for only one year; a three-year follow-up might have better revealed the impact of lifestyle on health.

Stressors, hardships, beliefs, and behaviors that affect health are not randomly distributed; they are socially structured. Smoking, exercising, and other individual health behaviors are not alternatives to socially structured inequalities, like the poverty, unfulfilling work, and economic hardships faced disproportionately by those with little schooling. The two are linked. Compared to people who are well educated, people with little education are more likely to be unemployed; if employed they do not have equal access to fulfilling, high-paying jobs, and they experience greater economic hardship, all of which are associated with the belief that one is powerless to affect one's life and one's health, and with health lifestyle. If *efforts* seem useless, if health and sickness are seen as outside one's control, what is the point of exercising, quitting smoking, or avoiding heavy drinking? (Wheaton 1990). Compared to a sense of powerlessness, a sense of personal control has consistent positive effects on health in our analyses. Some of the effects are mediated by health lifestyle, and some are direct. Beliefs about personal control generally represent realistic perceptions of objective conditions (Mirowsky and Ross 1989). The failures structured into the life of a person who has not finished high school are likely to shape a sense of powerlessness, which ultimately affects health, in part through lifestyle and in part directly. Social-psychological resources and health lifestyle are not alternative explanations to structured inequality; they link inequalities in education, work, and economic circumstances to health.

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Appendix A. Sense of Control Measure: Work, Family, and Well-Being Sample

Claiming Control Over Good Outcomes:

(1) "I am responsible for my own successes."
(2) "I can do just about anything I really set my mind to."

Claiming Control Over Bad Outcomes:

(3) "My misfortunes are the result of mistakes I have made."
(4) "I am responsible for my failures."

Denying Control Over Good Outcomes:

(5) "The really good things that happen to me are mostly luck."
(6) "There's no sense planning a lot—if something good is going to happen it will."

Denying Control Over Bad Outcomes:

(7) "Most of my problems are due to bad breaks."
(8) "I have little control over the bad things that happen to me."

Responses to control questions (1 through 4) are coded –2 = strongly disagree, –1 = disagree, 0 = neutral, 1 = agree, 2 = strongly agree. Responses to lack of control questions (5 through 8) are coded 2 = strongly disagree, 1 = disagree, 0 = neutral, –1 = agree, –2 = strongly agree. A means score sense-of-control index was created from these questions, coded from low sense of control (–2) to high sense of control (2) (alpha reliability = .68). This measure is conceptually similar to the personal control component of Rotter's (1966) locus-of-control scale (modified for community surveys by using Likert scale responses rather than forced-choice responses) and to Pearlin et al.'s (1981) mastery scale. The major difference is that our scale balances statements claiming control against those denying control, and statements about good outcomes against those about bad outcomes (Mirowsky and Ross 1991).

Appendix B. Drinking Measure: Health Practices Sample

Drinking Frequency:

"On average, how often do you drink any alcoholic beverages such as beer, wine, or liquor?"

Drinking frequency is coded in number of days per week (0 = never, .10 = less than once a month, .25 = once a month, .4 = 1 to 2 days a month, .5 = 2 days a month, .7 = 2 to 3 days a month, .75 = 3 days a month, .9 = 3 to 4 days a month, 1 = 1 day a week, 1.5 = 1 to 2 days a week, 2 = 2 days a week, 2.5 = 2 to 3 days a week, 3 = 3 days a week, 3.5 = 3 to 4 days a week, 4 = 4 days a week, 4.5 = 4 to 5 days a week, 5 = 5 days a week, 5.5 = 5 to 6 days a week, 6 = 6 days a week, 7 = every day.

Drinking Quantity:

"On the days that you drink how many drinks do you have per day, on the average?"

Drinking quantity is coded according to the number of drinks per day (from 0 drinks to 12 or more drinks per day, coded 0 to 13).

Drinking Quantity/Frequency Scores:

Scores are computed by multiplying the number of days per week a person drinks by the number of drinks reported for the average day. We categorized quantity/frequency scores into four categories because the effect of drinking on health is probably nonlinear. Abstainers never drink (28 percent of the sample; N = 831). Rare drinkers report one drink or less per week (26 percent of the sample; N = 777). Moderate drinkers drink between 1 drink per week to about 3.5 drinks a day (25 drinks a week) (43 percent of sample; N = 1294). Heavy drinkers drink more than 25 drinks per week (2 percent of the sample; N = 72). Moderate drinking is the reference category in the regression analyses.

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