

# Chapter 1 | The SES and Health Gradient: A Brief Review of the Literature

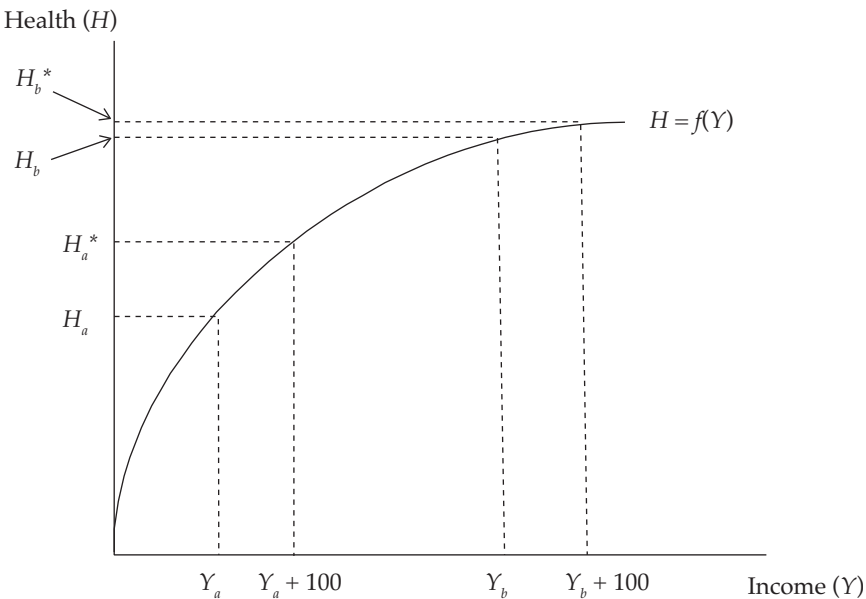
William Evans, Barbara Wolfe,  
and Nancy Adler

Numerous studies have documented a positive gradient between socioeconomic status (SES) and health—the better off individuals are, the better their health. The positive relationship between good health and higher SES is generally accepted, but until we understand both the nature of the relationship and what explains the link, policy may be ineffective in substantially reducing disparities across groups.

The graded association between various indicators of SES and health holds across all ages and for all countries in which it has been studied. The gradient emerges in relation to a range of health indicators, including mortality, morbidity, measures of general health, health habits, and functional limitations. These health indicators are associated with a range of alternative measures of SES, such as income, wealth, occupation, and education. These indicators of SES are in turn related to one another, but each has unique aspects. Each provides different material and social resources. In addition, they differ in terms of their potential role in serving as a cause of health and as an outcome of health status. For example, income may fluctuate as a result of poor health, while simultaneously poor health may be the result of financial constraints. In contrast, education is generally established relatively early in life and is less likely to be subject to changes in health status.

Figure 1.1 illustrates the general shape of the relationship between income and health when compared across individuals or groups or countries. The horizontal axis measures income, the vertical axis measures a

Figure 1.1    The Income-Health Relationship



Source: Authors' figure.

positive health outcome such as life expectancy, and the curve represents the empirical relationship between the two variables. Although higher income is associated with better health at all levels, the steepest association is at the bottom of the income distribution. As a result, and as shown in the figure, the relative gain in a given health outcome as the result of adding \$100 to a person's income ( $Y_a$  to  $Y_a + 100$  versus  $Y_b$  to  $Y_b + 100$ ) is greater for those whose incomes are lowest. This graph clearly portrays that the marginal benefit of additional income declines as income rises. Adding an extra \$100 to income at  $Y_a$  improves outcomes  $H_a$  to  $H_a^*$ , but that same \$100 increment at  $Y_b$  improves outcomes only marginally from  $H_b$  to  $H_b^*$ .

The income-health gradient portrayed in figure 1.1 is widely interpreted to indicate that income causally influences health. At the same time, poor health can reduce a person's productivity and hence income and wealth. These two scenarios lead to the question of whether low income leads to poor health or whether poor health leads to low income. Given that both may be true, the more appropriate question is the extent to which income affects health and the extent to which health affects income.

A third scenario is also possible: a correlation between SES and health may not simply represent the impact of a given aspect of SES on health or the impact of health on SES but also reflect an underlying common determinant of both health and SES. For example, factors such as motivation or genetics could account for the presence of both low income and poor health. To date, these alternatives remain as active hypotheses of what lies behind the income-health gradient.

In this chapter, we attempt to set the groundwork for the volume by reviewing the existing evidence on the SES-health relationship. This includes discussions of the basic descriptive models that may enable us to better test the nature of the gradient, two of the more influential streams of empirical literature attempting to understand the gradient, and finally some assessment of which alternative approaches may allow us to make progress in increasing our understanding of the SES gradient in health.

## DESCRIPTIVE EVIDENCE

Literally thousands of papers document the SES-health gradient. These studies use different samples, outcomes, measures of SES, and statistical methods and cover very different periods. Rather than try to summarize this vast literature, we present a number of samples and similar models to document the persistence of the SES-health link and its changing nature over time.

Although the gradient occurs in relation to health, illness, and mortality at every stage of life, the strength of the gradient varies at different ages. The gaps in health are greatest in mid- to late adulthood, when rates of disease begin to rise and more variation is linked to socioeconomic factors. The gap narrows after age sixty-five, possibly because of differential survival and the buffering effects of safety net programs, including Medicare, that are available starting at age sixty-five. Despite the somewhat weaker gradient in childhood, this period is important to examine for two reasons. First, the SES-health gradient for children is less susceptible to reverse causation concerns because it is less likely that poor health is “causing” low income.<sup>1</sup> Second, although the magnitude of SES differences is greater in adulthood, previous work has provided evidence that the origin of the SES-health gradient among adults has its roots in childhood (Case and Paxson 2008; Singh-Manoux et al. 2004).

To illustrate the breadth of the income gradient for children, we use data from the 2001 through 2003 National Health Interview Surveys (NHIS), an annual survey designed to measure the health status of the U.S. noninstitutionalized population. From the NHIS, we select a popula-

tion of school-age children, age six through seventeen, giving us 39,357 observations.<sup>2</sup> We focus on seven measures of child health. All of the measures are characterized as dummy variables, in which the variable equals one if the child has the condition and zero otherwise, and all are constructed such that the realization of the outcome is a measure of poor health. These outcomes are whether the child has fair or poor health (on a 5-point scale) as reported by the adult in the house; has missed ten days or more of school in the past year due to injury or illness; has a physical, mental, or emotional condition that limits activity; had a hospital stay in the previous twelve months; had an emergency room visit in the previous twelve months; had an injury or poisoning in the past year; and has ever been diagnosed with asthma.

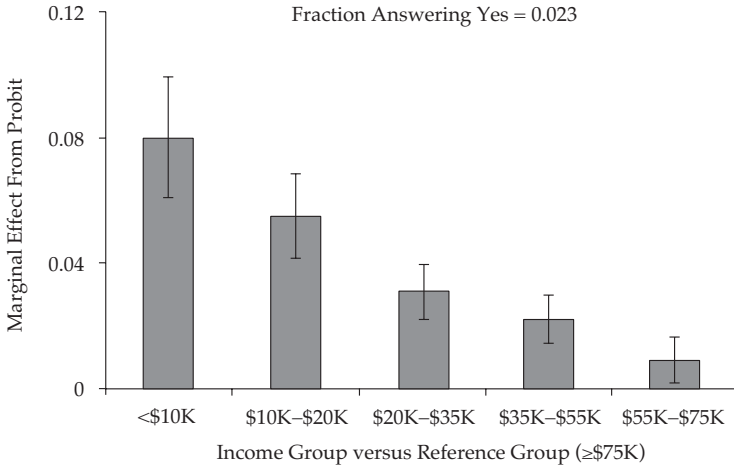
For each outcome, we run a simple probit model controlling for a variety of characteristics.<sup>3</sup> The key covariate in these models is a measure of family income, which is reported by an adult within the household. The variable is categorical, and we break it into six broad income categories (<\$10,000, ≥\$10,000 and <\$20,000, ≥\$20,000 and <\$35,000, ≥\$35,000 and <\$55,000, ≥\$55,000 and <\$75,000, and ≥\$75,000). In the probit models, we include dummy variables for the lowest five income groups with the reference group being those with \$75,000 or more in family income.<sup>4</sup> In figures 1.2 to 1.8, we graphically report the marginal effects from the probit on the income dummies for each outcome. These effects represent the change in the probability that the child will have that negative health indicator as one moves from the highest income group to the particular income group. In the graphs, we include error bars signaling the 95 percent confidence interval for each estimate.

Parental income is significantly related to the probability that children will experience five of the seven outcomes, but no association is found with injuries or poisonings in the previous year or for a diagnosis of asthma. The gradient is rather steep for most outcomes, as can be seen in looking at the association of parental income with the likelihood that children are in poor or fair health. Only 2.3 percent of children are reported to be in fair or poor health; however, a child from a family with less than \$10,000 in family income has an 8 percentage point higher probability of being reported in fair or poor health than a child in the highest income group. This marginal effect is almost four times the sample mean and represents a large increase in poor health as one moves from higher- to lower-income groups.

Two things are notable in figures 1.2 to 1.6. One is that children's health improves at each higher level of family income, even at upper levels. Children whose parents have an income of \$55,000 to \$75,000 are significantly

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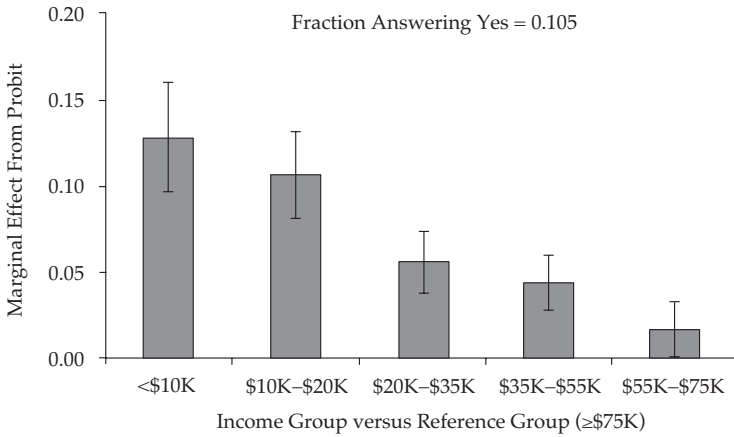
Figure 1.2 Marginal Effects on Income Dummy Variables, Children, Fair or Poor Health



Source: Authors' calculations based on National Health Interview Survey 2001–2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

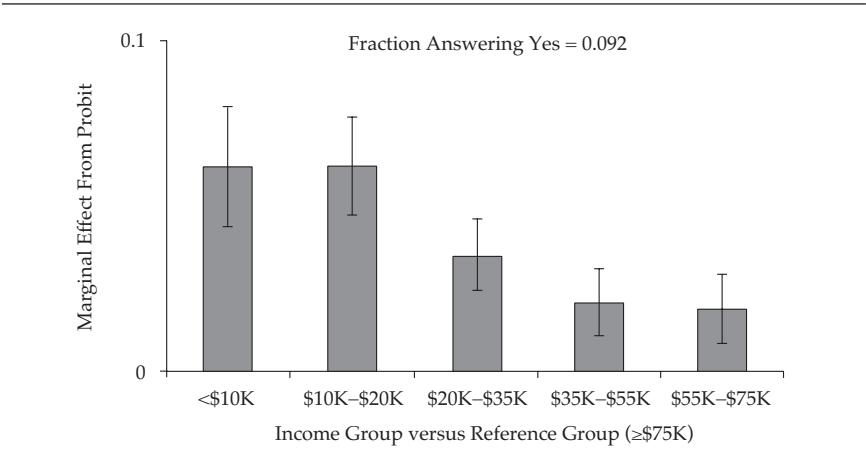
Figure 1.3 Marginal Effects on Income Dummy Variables, Children, School Absence Ten Days or Longer



Source: Authors' calculations based on National Health Interview Survey 2001–2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

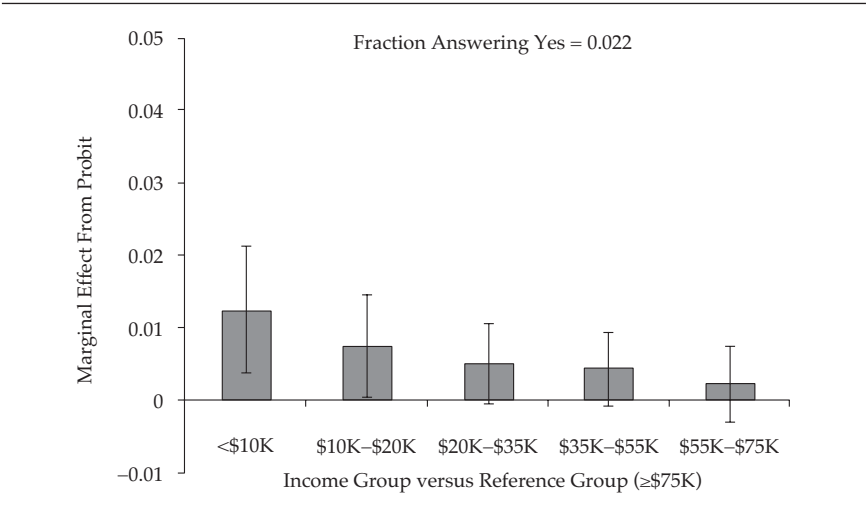
Figure 1.4    Marginal Effects on Income Dummy Variables, Children, Limitation on Activity



Source: Authors’ calculations based on National Health Interview Survey 2001–2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

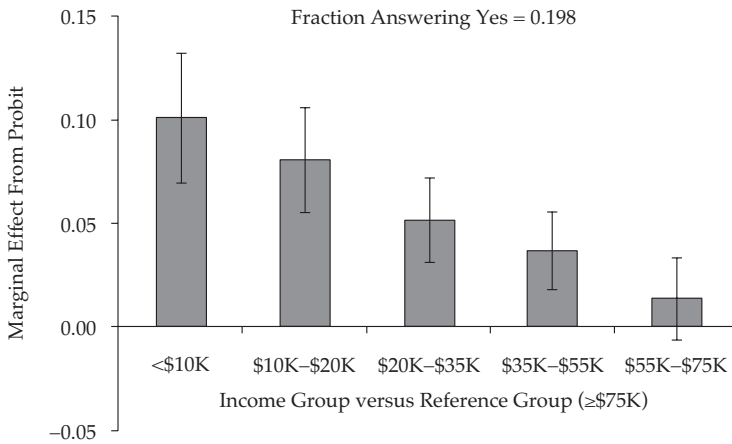
Figure 1.5    Marginal Effects on Income Dummy Variables, Children, Hospital Stay



Source: Authors’ calculations based on National Health Interview Survey 2001–2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

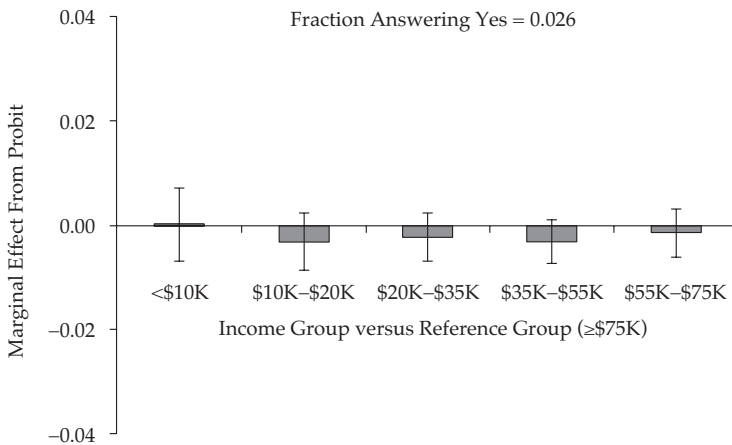
Figure 1.6 Marginal Effects on Income Dummy Variables, Children, Emergency Room Visit



Source: Authors' calculations based on National Health Interview Survey 2001-2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

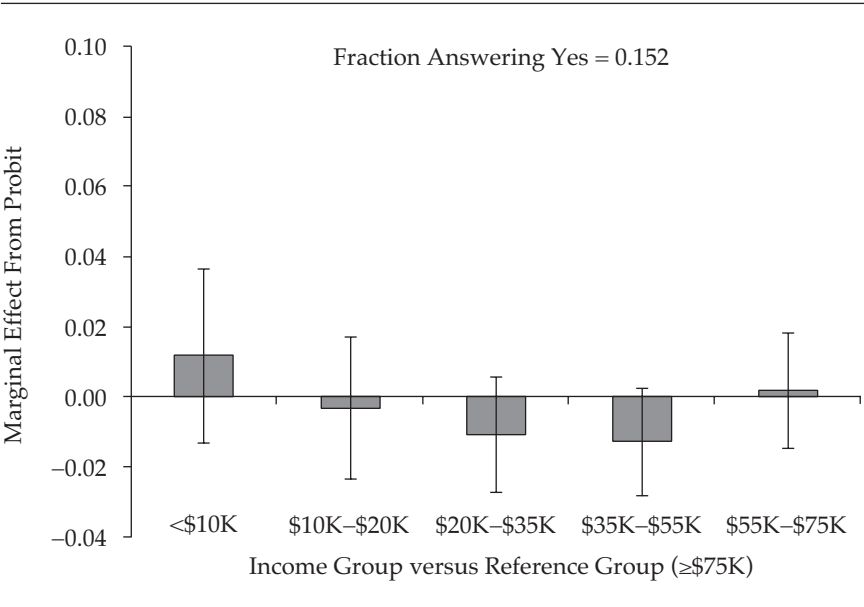
Figure 1.7 Marginal Effects on Income Dummy Variables, Children, Injury or Poisoning



Source: Authors' calculations based on National Health Interview Survey 2001-2003 (National Center for Health Statistics n.d.).

Note: Error bars represent 95 percent confidence intervals.

Figure 1.8    Marginal Effects on Income Dummy Variables, Children, Asthma



*Source:* Authors’ calculations based on National Health Interview Survey 2001–2003 (National Center for Health Statistics n.d.).  
*Note:* Error bars represent 95 percent confidence intervals.

more likely to be in fair or poor health than those whose family incomes exceed \$75,000 are. The second is that although improvements in health occur across the range of family income, the graphs show a declining benefit of higher income: an additional \$10,000 at the bottom of the income distribution is linked to a greater improvement in the child’s health than is an additional income increase of \$20,000 at the top.

The strength of the SES-health relationship is comparably large for adults. We document this using data from the Behavioral Risk Factor Surveillance System (BRFSS), an annual cross-sectional sample of the U.S. noninstitutionalized population started by the Centers for Disease Control and Prevention (CDC) in 1984. Only fifteen states participated in the 1984 BRFSS, but by 1994, BRFSS was collecting data from all states, the District of Columbia, and three U.S. territories.

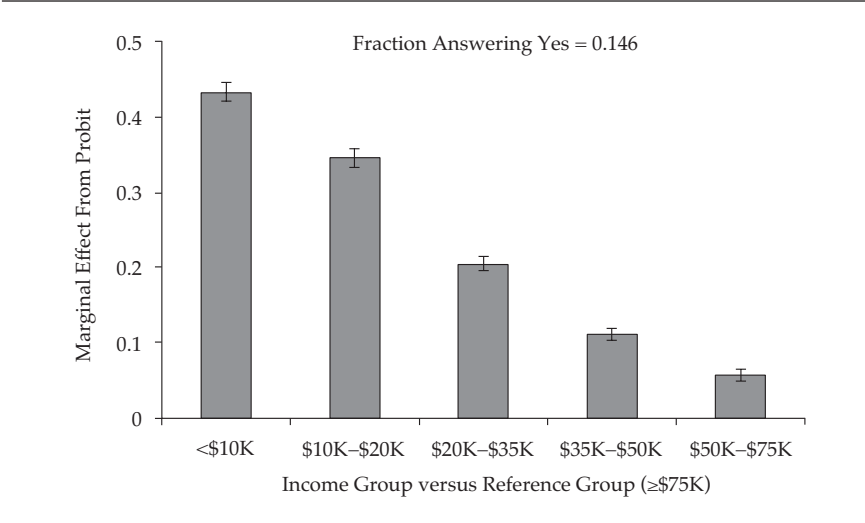
Our sample of adults between age eighteen and seventy-four from all fifty states and the District of Columbia consists of 1,155,100 observations

from the 2005 through 2008 BRFSS surveys. We estimate a series of probit models with a variety of health variables as outcomes. Health outcomes are coded as absent (0) or present (1), where 1 indicates the presence of an adverse outcome. We generate estimates for three omnibus measures of health: Did the person report fair or poor health? Any bad mental health days in the past thirty days? Any bad physical health days in the past thirty days?<sup>5</sup> We also estimate for five measures of health habits: Is the respondent a current smoker? Obese? Overweight? Did the respondent get no exercise in the past month? Does he or she rarely eat fruits and vegetables? For each model, we control for a variety of variables and we use two popular measures of SES.<sup>6</sup> The first is a measure of family income using the same categories we used in the analysis of the NHIS, again using those with family incomes at or exceeding \$75,000 as the reference group. Because annual income can be volatile from one year to the next, in the economics literature, education is often used as an indicator of socioeconomic status or permanent income, especially when using cross-sectional data. In the second set of models, we examine the association of education with health outcome and replace the income dummy variables with three levels of education (dummy variables for those with less than a high school degree, a high school degree, or some college) using a reference group of those with a college degree.

The results using income are reported graphically in figures 1.9 through 1.16. In each figure, we report the marginal effects from the probit model where the numbers represent the percentage point difference in incidence of each adverse health outcome or habit in reference to the incidence in the highest income group. In all cases, the marginal effects are positive, meaning that those in the highest income group have better health than those with lower income. The bars at the top of each graph represent the 95 percent confidence interval for each marginal effect, and in all cases the marginal effects are statistically significant. The results across the eight measures of health show a strikingly similar pattern, the lowest income groups having decidedly worse health outcomes than those in higher-income groups. For all outcomes except current smoking and being overweight, the decline in the size of the marginal effect is monotonic as family income rises. The marginal effects are, in most cases, very large. For example, in figure 1.9, those with <\$10,000 income have about a 44 percentage point higher probability of reporting fair or poor health than someone with income in excess of \$75,000, nearly three times the sample mean. The smallest marginal effect is in figure 1.16, which shows that the lowest income group is 4 percentage points more likely to have limited fruit and vegetable consumption, but even this result is one fifth or 20 percent of the sample mean.

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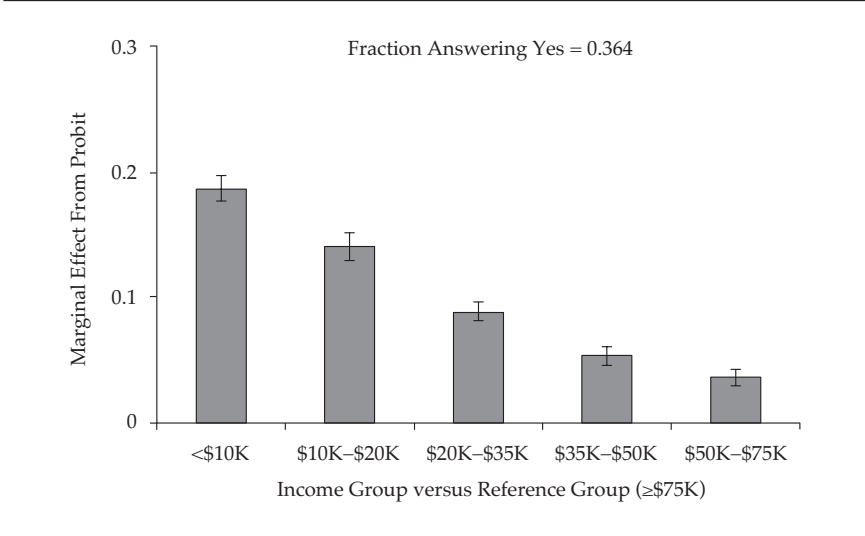
Figure 1.9    Marginal Effects on Income Dummy Variables, Adults, Fair or Poor Health



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

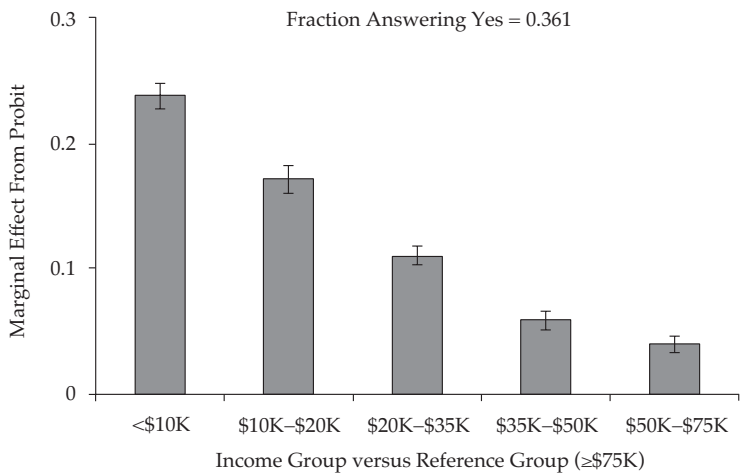
Figure 1.10    Marginal Effects on Income Dummy Variables, Adults, Mental Health Days



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

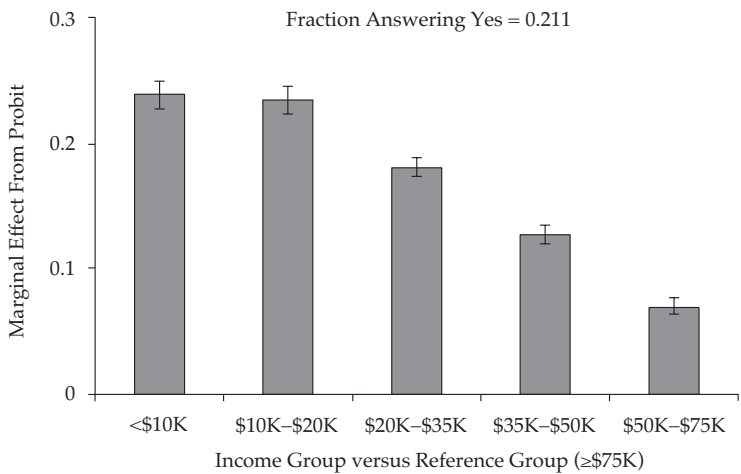
Figure 1.11    Marginal Effects on Income Dummy Variables, Adults, Bad Physical Health Days



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

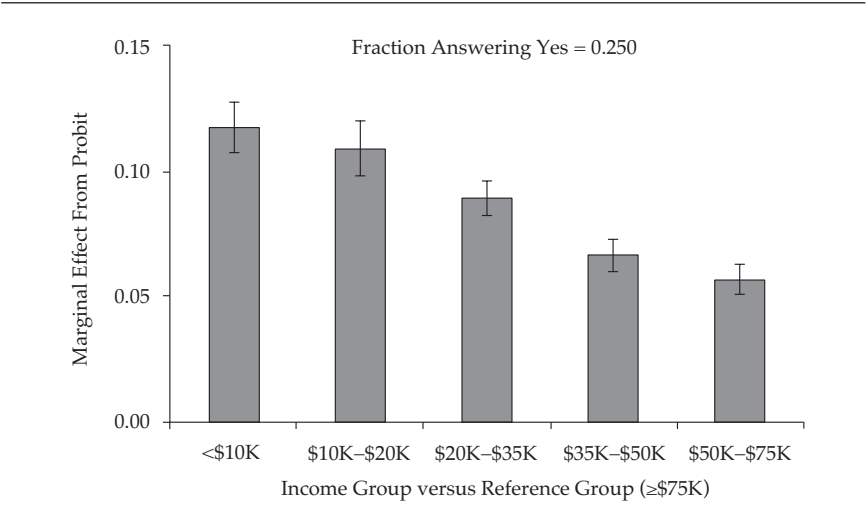
Figure 1.12    Marginal Effects on Income Dummy Variables, Adults, Current Smoker



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

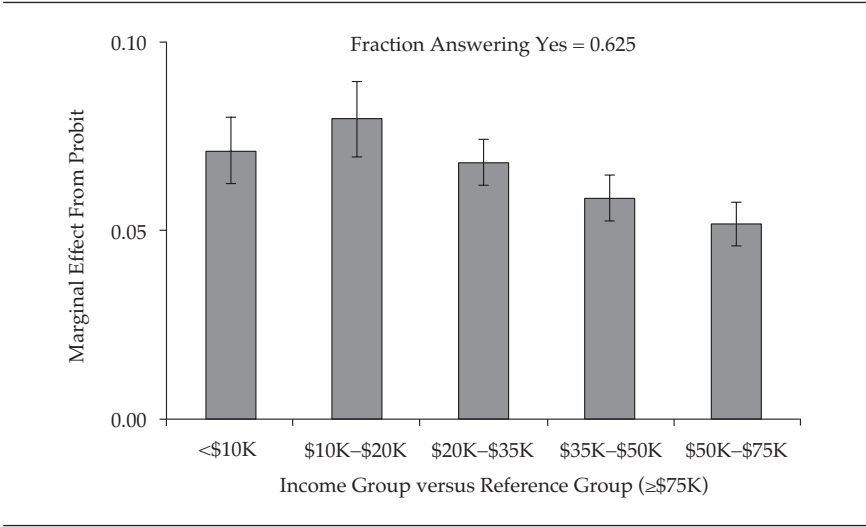
Figure 1.13 Marginal Effects on Income Dummy Variables, Adults, Obese



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

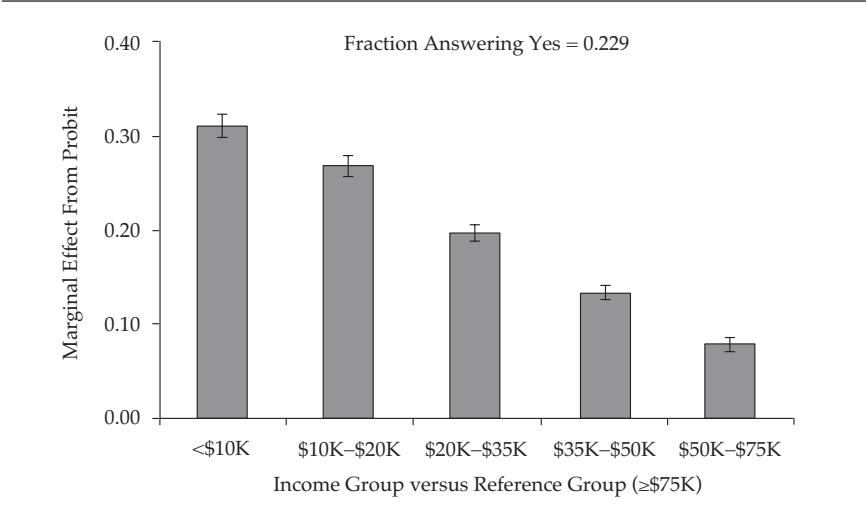
Figure 1.14 Marginal Effects on Income Dummy Variables, Adults, Overweight



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

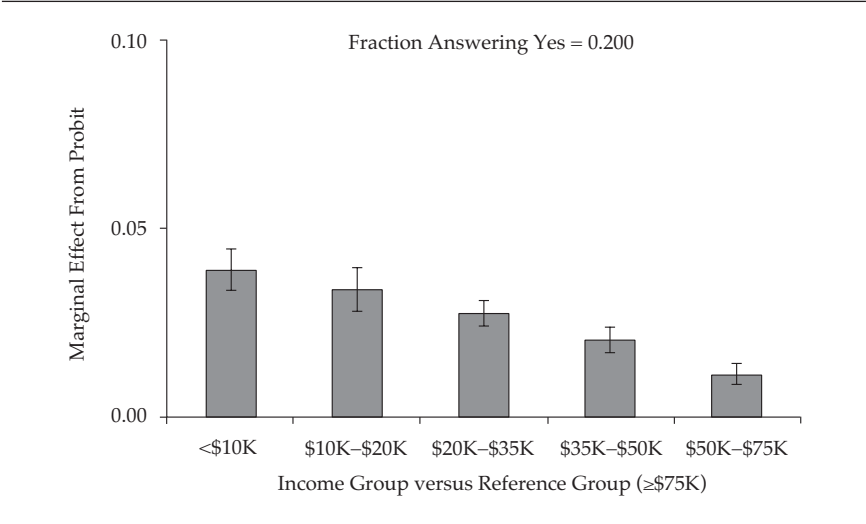
Figure 1.15    Marginal Effects on Income Dummy Variables, Adults, No Exercise



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

Figure 1.16    Marginal Effects on Income Dummy Variables, Adults, Ages Eighteen to Seventy-Four, Limited Fruits and Vegetables



Source: Authors' calculations based on Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention 2005–2008).

Note: Error bars represent 95 percent confidence intervals.

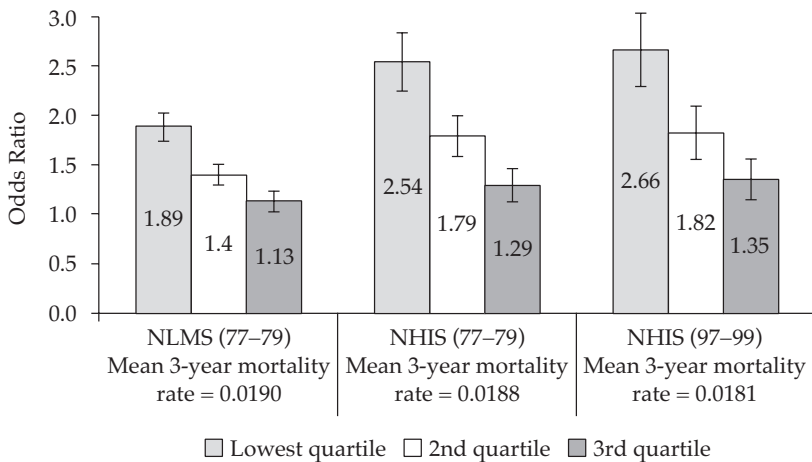
## CHANGE IN STRENGTH OF SES GRADIENT OVER TIME

Although the SES-health gradient is a widespread phenomenon, occurring across nations and over time, the steepness of the gradient varies considerably. Variations in the steepness of the gradient may reflect the degree of inequality in different countries or different times in history. A number of authors have documented that the United States has experienced a large increase in financial inequality over the past forty years. The rise in inequality has occurred for almost all measures of income, wealth, wages, and earnings. As just one example, the U.S. Census Bureau (2010) reports that between 1967 and 2008 the ratio of incomes at the 90th and 10th percentiles of the household income distribution has increased from 9.26 to 11.97, an increase of almost 30 percent. Because during that time the income inequality expanded, some studies document an increase in the strength of the SES-health gradient as well (Pappas et al. 1993; Preston and Elo 1995; Feldman et al. 1989; Crimmins and Saito 2001).

In the next section, we add to this literature using two longitudinal mortality surveys: the public use National Longitudinal Mortality Survey (NLMS) and the NHIS Multiple Cause of Death file. Both datasets have roughly the same structure in that respondents from different cross-sectional surveys are followed in the National Death Index (NDI) for a fixed period, allowing one to construct a longitudinal sample from inherently cross-sectional data. The data from the NDI identify if and when a respondent dies and the cause of death. The data also contain administrative information on the deceased, such as Social Security numbers, allowing records to be matched to particular surveys. The public use NLMS follows respondents for nine years from various Current Population Surveys fielded over the years 1977 to 1979. The NHIS Linked Mortality file follows respondents from the 1986 to 2004 NHIS annual surveys in the NDI through December 31, 2006. Because the NLMS starts with samples of people from the late 1970s, we consider the NHIS samples from the 1987 to 1989 and the 1997 to 1999 periods, giving us datasets roughly two decades apart.

From each longitudinal survey, we select a sample of adults between age eighteen and seventy-four, construct an indicator that identifies whether the survey respondent died in the first three years after the initial survey, and estimate a simple logit model with the mortality variable as the outcome of interest. We use a small set of covariates including a quadratic term in age and controls for race-ethnicity, marital status, and gender. In one set of models, we use the same education breakdowns as in figures 1.9 through 1.16, and in a second set use quartiles of family in-

Figure 1.17 Odds Ratio for Income Variables, Adults



Source: Authors' calculations based on the National Longitudinal Mortality Survey 1987-1989 (National Heart, Lung, and Blood Institute 1995) and Public-use National Health Interview Survey Linked Mortality Files 1997-1999 (National Center for Health Statistics 2010).

come.<sup>7</sup> In figure 1.17, we report the odds ratios from the logit models in the model with income quartiles as the covariates of interest.<sup>8</sup>

The results in figure 1.17 report a striking income-mortality gradient that increased over the last two decades of the twentieth century. We use as covariates dummy variables for the three lowest income quartiles. In the initial period, those in the lowest quartile of income have a three-year mortality rate that is 1.89 times that of people in the highest income group. By the 1997 to 1999 period, this number has increased significantly to 2.66. The odds ratios for the second and third income quartiles increased from 1.4 to 1.82 and 1.13 to 1.35, respectively, over the same period.

This evidence is for one country only, the United States. Given that the United States has been unique in its failure to provide universal health-care coverage, a common assumption is that SES differences are largely due to differences in access to health care. If so, the gradient should be greater within the United States than within other countries. Is this the case? In table 1.1 we present results from surveys in Organisation for Economic Co-operation and Development (OECD) countries on self-reported health for adults. The surveys were done between 2001 and 2008, most in 2007. The table shows the ratio of the proportion of those reporting good

Table 1.1 Disparities in Health by Socioeconomic Status

Country	Year-OECD Data	Perceived Health Status $\geq$		
		Good Q1	Good Q5	Ratio Q1/Q5
Australia	2004	76.5	93.1	82%
United States	2007	77.0	95.6	81%
France	2006	57.9	85.0	68%
New Zealand	2007	89.7	93.2	96%

*Source:* Authors' calculations based on OECD (2012).

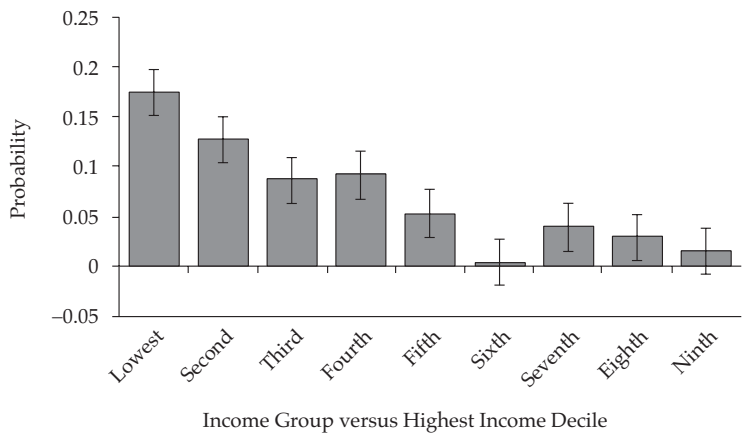
*Note:* OECD = Organisation for Economic Co-operation and Development; Q = quarter.

health or better for those whose incomes are in the lowest quintile to those in the highest quintile. These ratios provide evidence of disparities in self-reported health for all included countries with the exception of New Zealand, which has a modest ratio of 96 percent.<sup>9</sup>

For Australia, we also conducted an analysis for adults using the same approach as for the United States, using the Household, Income and Labour Dynamics in Australia Survey (HILDA), a panel dataset funded by the Australian government and centered at the University of Melbourne. HILDA began in 2001 with an initial sample of nearly 8,000 households and 20,000 individuals; here we report on data from 2006.<sup>10</sup> We run regressions over adults age twenty-five to sixty-four, controlling for age, sex, race, and state or territory. In figure 1.18, we report the probability of reporting fair or poor health by income decile. The results are quite consistent with those for the United States and suggest that those with lower incomes have poorer general health. Results illustrated in figure 1.19 show a similar pattern for psychological distress. Figure 1.20 shows the probability of having a long-term health problem by decile and suggests that the probability is far higher for those in lower income deciles. These results, then, are consistent with those for the United States in terms of general health and long-term health.

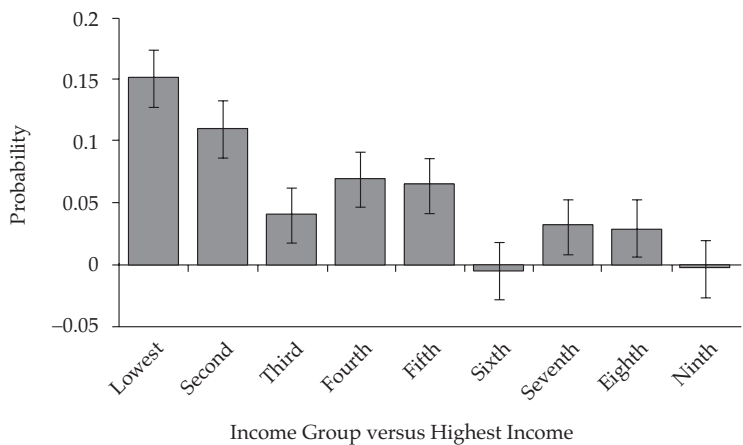
The Survey of Health, Aging, and Retirement in Europe (SHARE) is a relatively new source of data that recently has been used to document the health disparities according to SES for a number of European countries. Mauricio Avendano, Arja Aro, and Johan Mackenbach (2005) use these data to document differences by education and income for self-perceived health, activity limitations, and long-term health problems. For each country, education is classified into three levels using the International Standard Classification of Education (ISCED), and then the odds ratio compares the lowest level with the middle and high education levels. Income is summed over household members, adjusted for household size by the

Figure 1.18 Marginal Effects of Household Income, Australian Adults, Fair or Poor Health



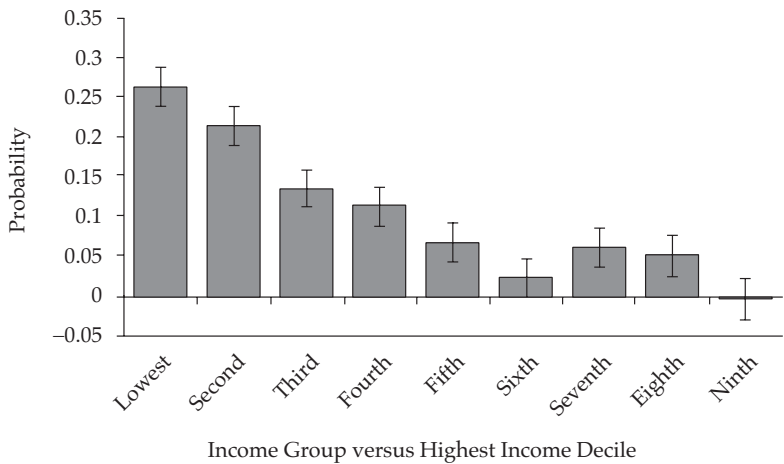
*Source:* Authors' calculations, with Jacqueline Homel, using the Household, Income and Labour Dynamics in Australia Survey (HILDA; Melbourne Institute 2006).  
*Note:* Income is equivalized household income for 2005. Error bars represent 95 percent confidence intervals.

Figure 1.19 Marginal Effects of Household Income, Australian Adults, Psychological Distress Risk



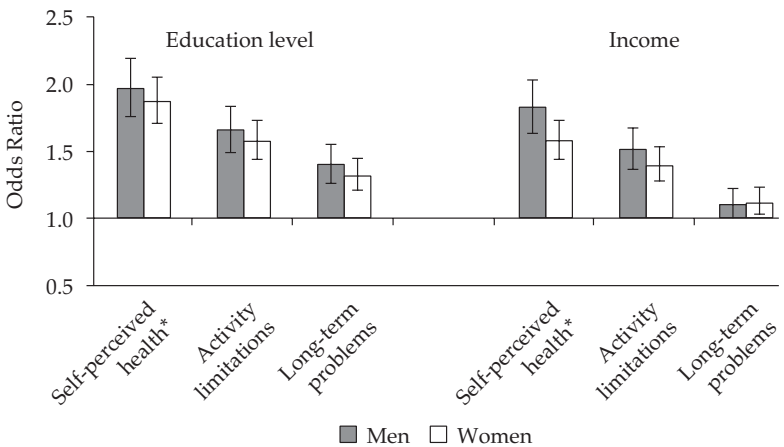
*Source:* Authors' calculations, with Jacqueline Homel, using the Household, Income and Labour Dynamics in Australia Survey (HILDA; Melbourne Institute 2006).  
*Note:* Income is equivalized household income for 2005. Error bars represent 95 percent confidence intervals.

Figure 1.20 Marginal Effects of Household Income, Australian Adults, Long-Term Health Condition



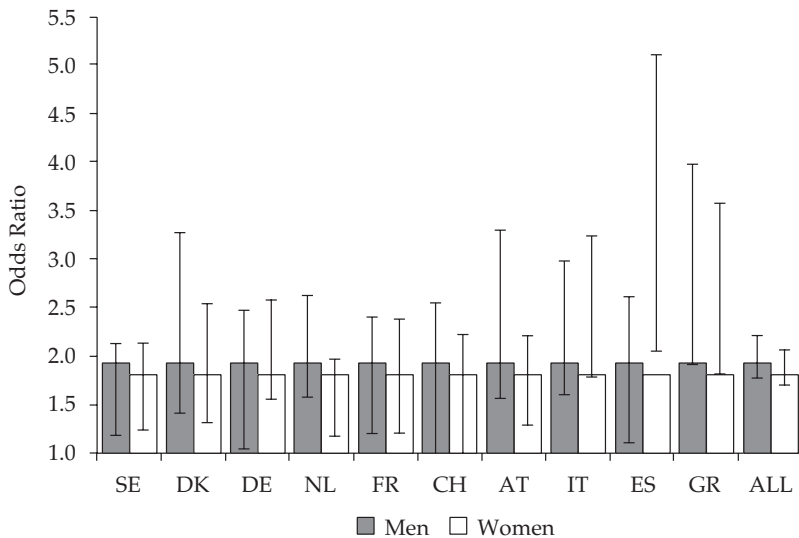
Source: Authors' calculations, with Jacqueline Homel, using the Household, Income and Labour Dynamics in Australia Survey (HILDA; Melbourne Institute 2006).  
Note: Income is equivalized household income for 2005. Error bars represent 95 percent confidence intervals.

Figure 1.21 Odds Ratio of General Physical Health Measures, Europe



Source: Avendano, Aro, and Mackenbach (2005, p. 90), reprinted with permission.  
Note: \*Less than good self-perceived health.

Figure 1.22 Odds Ratio of Self-Perceived Health, Europe



Source: Avendano, Aro, and Mackenbach (2005, p.93), reprinted with permission.

Note: Outcome is less than good self-perceived health.

SE = Sweden; DK = Denmark; DE = Germany; NL = Netherlands; FR = France; CH = Switzerland; AT = Austria; IT = Italy; ES = Spain; GR = Greece.

square root of the number of persons in the household, and placed into quintiles. The reported ratio then compares the two highest to the two lowest quintiles. Figure 1.21 shows these differences by sex across the SHARE countries. The odds ratios of reporting the poor health outcome are considerably above one for all of these health indicators for both men and women in Europe. The largest differences are for self-perceived health followed by activity problems. Differences are larger for education than income when using current income. Figure 1.22 shows differences for self-perceived health by education level for the ten countries in SHARE (Avendano, Aro, and Mackenbach 2005). Although disparities clearly differ across the ten countries, all ten experience disparities based on education level.

## DESCRIPTIVE MODELS

Although the results in the previous section outline a robust relationship between SES and health, what lies behind this relationship? Economists have developed a set of simple models that may help us to consider the

possibilities systematically. At the core is a utility maximization model in which individuals and families attempt to maximize utility or well-being in which health status is an argument; that is, health itself is a component of well-being. To produce better health, resources including time, health care, and other health-producing inputs are tapped but constrained by income and available time and, in some instances, may be traded off to maximize other components of well-being. Income limits the resources available to produce good health. A similar model is used at the family level to produce children's health, in which parental income and time are constraints. Utility or well-being in this model is a function not only of health but also of other commodities, and evaluation of these may depend in part on the community of residence and the expectations of the individual. Health is also a factor in determining the income constraint, influencing the productive value of time as might be captured by a person's wage rate as well as hours available to work. Thus, for those of working age, health is a factor that produces market income. Of course, the market value of time is based on demand for labor along with market imperfections. Thus the community in which one lives can influence labor market opportunities and the cost of place-specific goods and services, including in particular housing.

The following models suggest a set of pathways by which having additional income might "buy" better health. The simplest model is the *absolute income hypothesis*, which suggests that rising income or wealth lead to better health through greater access to inputs into better health, including, for example, more or better health care, healthier food, recreational facilities, and safer housing farther from sources of pollution. An implication of this hypothesis is that a community with more equal income will tend to have better average health than a community with more inequality when two communities with equal average income are compared. This prediction is generated by the concave relationship between health and income depicted in figure 1.1. A loss in income by someone with a high income level yields little change in aggregate health because the marginal return to income is relatively low at that point in the curve. In contrast, income received by someone with a low original value results in a much greater increase in health. The expected result is an increase in average health within a community (or country). Using the same type of argument, Angus Deaton (2001) suggests that if the absolute income hypothesis were true, then redistribution from rich to poor countries would in principle improve worldwide average health.

A variant of this alternative is the *absolute deprivation* or *poverty hypothesis*, which states that those with the lowest incomes face poorer health and a greater risk of mortality owing to a variety of factors associated with

extreme poverty. The mechanisms are similar to those in that the poor have the least access to healthful food, and so on, but suggest that disparities are concentrated at the bottom of the SES distribution versus the rest of the population rather than represents a continuous gradient. This has some support in that the gradient is steeper at the bottom but is not discontinuous at the level of poverty. It is also difficult to find a set of purchased items that can explain disparities across groups. The usual explanation for poorer health among those in poverty is lack of access to health care. However, the gradient exists in countries with and without universal health-care coverage and researchers find a health-SES gradient even among the elderly in the United States, who have universal coverage through Medicare (Menchik 1993; Minkler, Fuller-Thompson, and Guralnik 2006; Singh-Manoux, Marmot, and Adler 2005; Cohen et al. 2008; Marmot 2006; Smith and Kington 1997). Access to resources for a healthier lifestyle is more limited among the poor and the poor are also exposed to more environmental hazards, but each of these explains only a part of the association between income and health (Mokdad et al. 2004).

The *relative income hypothesis* focuses on an individual's income relative to others in the same group rather than an absolute income. A related theory is the *relative position hypothesis*. According to this concept, health outcomes are tied to one's relative rank in society. This is very similar to, and includes, the relative income hypothesis but extends the concept of relative position to measures of rank other than income, such as occupational or educational rank, and suggests that lower rank itself may be damaging to health.

For example, in the Whitehall studies of British civil servants, a relatively homogenous population with high employment, universal health care, and high pay, there are not only large mortality differences between those with low and high occupational rank within the civil service system but also increases in mortality at each lower job grade (Marmot et al. 1991; Marmot 2005). A shortcoming of the Whitehall studies is that although the sample is relatively homogenous, initial placement into occupational rank can signal underlying characteristics about the worker. Given these concerns, other authors have examined the impact of changing status on mortality and found a protective impact of enhanced social status even within populations with substantial material resources. For example, Donald Redelmeier and Sheldon Singh (2001a) demonstrated that Academy Award winners live longer than those nominated, and Matthew Rablen and Andrew Oswald (2008) found similar effects of being awarded a Nobel prize. Christine Eibner and William Evans (2005) found that after controlling for absolute income, mortality is higher for those who earn less compared to their peers of similar race, age, education, and state. In a related study us-

ing data for China, Eiji Mangyo and Albert Park (2011) documented that respondents who feel their living standard is poorer than their peers (such as neighbors, classmates, relatives, or coworkers) tend to have poorer self-reported health status and worse mental health than those who do not feel materially deprived.

Explanations for the health-damaging effects of low rank generally focus on low status as a stressor that operates through social emotions such as shame that have physiological consequences (Dickerson, Gruenewald, and Kemeny 2004). Erzo Luttmer (2005) found that self-reported happiness declines as average income in the local community rises. A study of healthy volunteers experimentally exposed to a cold virus after completing questionnaires shows that individuals who view themselves as falling lower on the social hierarchy are more likely to develop a clinical cold than their counterparts (Cohen et al. 2008). Further evidence that stress processes associated with low social rank play a role in the impact of SES on health comes from an imaging study that found that individuals with self-rated low status have diminished gray matter in a section of the brain that modulates stress compared with those who rank themselves higher (Gianaros et al. 2007).

## DISENTANGLING THE CAUSAL IMPACT OF INCOME ON HEALTH

The various hypotheses linking income and health are not mutually exclusive, and each has some support from empirical findings. Each assumes that the causal direction flows from SES to health. The true relationship is likely more complicated, however.

Researchers attempting to sort out the pathways linking SES to health have faced difficulties in disentangling cause and effect largely due to reverse causation and omitted factors. Reverse causation is simply that poor health may directly lead to lower incomes. Put another way, do those with good health earn more and have better nutrition and access to better health care? Additionally, there may be unobserved characteristics that jointly determine both SES and health such as genetic endowments, parental SES, and so on. In the following section we report on what we view as the most promising literature that has tried to advance our knowledge in this area.

### Selective Literature Review

Within the SES-health literature, the three most commonly used measures of status are income (and wealth), education, and occupation. The logic

behind using income is that more income allows for better inputs into the production of health, such as healthier consumption (for example, nutrition), better access to health care, greater access to opportunities for exercise, and more public safety and lower environmental risks via neighborhood choice. The problem of reverse correlation, however, is likely greatest for income given that poorer health almost surely reduces earning opportunities. Wealth can be thought of as accumulated income and hence may avoid the contemporaneous issue of reduced work hours with poor health. Yet chronic conditions place demands on wealth so that the issue of endogeneity partly remains. Education is less problematic, but a child's health may limit education, so endogeneity is not entirely avoided. In addition, education does not completely capture access to resources and so may miss part of the link. Finally, occupation is mainly relevant for only the working-age population and those in the labor force, limiting the study to a subset of the population. The problems are lessened in studying children, and examining the gradient among them provides insight into the causal ties between SES and health. The use of natural experiments also provides better control over causal direction. These are the two literatures we briefly review in the following section.

### Research Focusing on Children

Children are studied to gain insight into the tie between SES and health under the general view that children do not influence household income but may be influenced by parents' SES. More income in the family means a less-binding income constraint so that more and better inputs into a child's health may be purchased (Grossman 1972). These might include better quality medical care and food, safer toys, better housing, and safer neighborhoods. Occupation will also change income and potentially alter the time spent with children. Mothers who work spend less time with children (Bianchi 2000), but across education groups, more-educated women spend much more time with their children than their counterparts do (Bianchi, Robinson, and Milkie 2007). Higher income may be used to purchase substitute care where quality may also influence the health, including mental health, of children. More parental education may be tied to greater productivity including producing child health. More-educated parents have greater access to information regarding the health and development of their children. Following medical directions, obtaining care on the recommended schedule, meeting children's nutritional needs, and providing educational activities all are likely forms of investment in child health.

Using children to study the SES-health link is not perfect, especially

when examining income effects, for several reasons. One, having a child with a chronic health problem may well reduce parents' work hours and hence income. However, only a small percentage of children and their families are likely in this category.<sup>11</sup> Two, one parent may reduce work time in the presence of very young children, so income may be reduced when very young children are in the home. If so, income—in the sense of permanent income—may be mismeasured. Three, children's health may be influenced by their activities (many children develop infectious diseases when they first spend extended time with other children), but these are not the measures of health we usually contemplate when considering the income gradient. Four, there may be a more general problem in accurately capturing general health, chronic conditions, and health shocks of children. Despite these difficulties, there are major gains to studying children because doing so substantially reduces issues of endogeneity.

The first paper to explore the question of the time path of the income gradient among children is by Anne Case, Darren Lubotsky, and Christina Paxson (2002). Using primarily cross-sectional data from the National Health Interview Survey for years 1986 to 1995 for children age zero to seventeen, they explore the time path using four age categories (zero to three, four to eight, nine to twelve, and thirteen to seventeen). Using the general health measure and ordered probit regression, they find clear evidence of an income-health gradient at all ages and a steepening with age. They explore this pattern as well using a panel dataset (Panel Study of Income Dynamics [PSID]) and find the same pattern. And using the panel data, they explore an alternative set of income measures, which all find the same steepening influence of income as children age.

This paper set off a chain of other studies—some use data from other countries that have universal health insurance and others use alternative datasets for the United States. For example, Janet Currie and Mark Stabile (2003) use data on Canada to ask whether the same steepening pattern exists for children under universal coverage. In addition to replicating the findings from Case, Lubotsky, and Paxson, they also attempt to understand whether the explanation for this pattern is that low-income children are less able to recover from a health shock than higher-income children or that low-income children are subject to more health shocks. Health shocks are defined by a set of chronic conditions. Their results suggest that, at least in Canada, low-income children recover as well as higher-income children from a health shock but have more of them.

Alison Currie, Michael Shields, and Stephen Wheatley Price (2007) explored the tie between income and child health in England using Health Survey for England (HSE) data on children between age two and fifteen. They found a positive tie between income and child health, though with-

out a significant increase as a child ages. Subsequent reanalysis and extension by Case, Diana Lee, and Christina Paxson (2008) comes closer to replicating the U.S. pattern, though it is clearly flatter than that for the United States. Rasheda Khanam, Hong Son Nghiem, and Luke Connelly (2009) examined Australian data and found a similar income gradient of health, though again flatter than that for the United States.

Finding statistically significant income gradients of health that increase with a child's age in these three countries suggests that whatever explains this tie is not eliminated by universal health-care coverage. The study for the United Kingdom suggests a flatter gradient than the studies of the United States, Canada, and Australia, yet all provide empirical evidence of both a positive tie between better child health and higher family incomes that appears to become steeper as a child ages. Examining effects associated with different ways of measuring income may influence our understanding of the link between income and health. Jason Murasko (2008), using data from the U.S. Medical Expenditure Panel Survey, explores dimensions of income including hot deck imputations for missing income, the use of income from one year versus a two-year average, and the use of wage income versus family income. He finds that the two-year average income (and family income versus wage income) shows a stronger tie to child health. But his use of only two years of income casts some doubt on the reliability of his comparison of permanent versus current income. Jason Fletcher and Barbara Wolfe (2010) use a longer panel (Early Childhold Longitudinal Study [ECLS] data) and find that the income gradient is greater using permanent income than either current income or a two-year rolling average. Because current income may be more subject to adverse impact from the child's health problems, this pattern provides some support for the causal pathway from income to health.

Is the effect of income cumulative? The approach used in both Khanam, Nghiem, and Connelly (2009) and Murasko (2008) is to use the earliest or prior health status to capture the influence of income on children younger than the age under study. Thus they suggest that including prior health (by an indicator of poor-fair health, for example) captures the influence of income on health until the most recent period. Under this perspective, estimates of the tie between income and health in the current period capture only the marginal influence of income on health. This approach reduces the coefficient on income but retains the overall pattern of results.

Might other factors lie behind the measured income gradient? A few studies add parental health as a possible correlate of income that might be related. The addition in the Khanam, Nghiem, and Connelly (2009) estimates reduces the statistical significance of income as a determinant of a child's health, though the steepening pattern as a child ages remains. The

authors suggest that this is a way in which income influences health, that is, a parent's poorer health is tied to lower incomes so that by including this channel the direct influence of income is reduced.

In sum, the existing literature confirms that children's health is tied to income with some steepening as children age, particularly in earlier childhood, and that universal health care is not enough to significantly reduce, let alone eliminate, this income gradient. Overall, the papers provide evidence of an increasing income gradient as children age, though why that is the case is not addressed in this research.<sup>12</sup> The strength of the tie between SES and health varies across the studies, in part reflecting differences in the country studied and access to care there; the exact measure of health and of SES used; and the time period and the precise hypothesis under study, which influences whether cross-sectional or panel data are used, as well as the additional factors controlled for in the estimates.

A number of these studies have also tried to determine whether the reason for an increasing gradient with age is that children in lower-income families experience more disease and injury (health shocks) or that they are less likely to recover from a shock. Studies to date have not clearly answered this question, but studies for both Canada and the United States suggest that children in low-income families are as likely to recover as children in higher-income families.<sup>13</sup> One problem with all of these studies is the limited and relatively arbitrary conditions included in each of the datasets.

A few studies have attempted to link poorer health as a child to longer-term prospects. Case and Paxson (2008) used height as an indicator of childhood health in studying longer-term outcomes such as education, occupation, and income outcomes. They used a variety of datasets from the United States and the United Kingdom, including Whitehall, the PSID, the Health and Retirement Study (HRS), and the National Longitudinal Survey of Youth (NLSY). They found that childhood health as measured by height is strongly associated with education, the probability of working during prime working-age years, and hourly wage rates and better adult health. The implications of this research are that childhood health has long-term consequences beyond health and life expectancy and hence that childhood SES has long-term consequences on adult well-being.

Other studies link childhood experiences to adult health. Michael Wadsworth and Diana Kuh (1997) used the British 1946 national birth cohort and found that poor conditions at home during early life predicted health conditions such as high blood pressure, schizophrenia, and chronic obstructive pulmonary disease by the mid-forties. Their findings suggest that part of the transmission of poor health among adults is tied to childhood illness, especially within the first two years of life. They also suggest

evidence of intergenerational effects, such that the risk of childhood bronchitis is greatest among children whose parents had an early childhood respiratory disease or who had smoked as adults. Andrea Danese and her colleagues (2009), using the Dunedin birth cohort, found that by age thirty-two those who were raised in low-SES homes had far higher age-related disease risk than others.<sup>14</sup> And Paul Fritjers and his colleagues (2010, 46) used the Boyd Orr study of a large sample of British children collected in sixteen locations in 1937 to 1939 whose official death records have been traced to 2005 to ask whether childhood SES conditions influence length of life. They state, "If we compare the 'best' and 'worst' set of observed child and household characteristics we can explain nine years of life." Thus the implications of this research are that childhood SES conditions are critical in determining life expectancy and health status as an adult more generally (for more, see Currie 2009).

### Linking Income and Health

The next and last set of papers we review are those that attempt to use natural experiments or changes in policy to examine the causal link between income or SES and health. In an experimental setting, we could easily identify the impact of income on mortality by randomly assigning large additions to income to one group and providing no additional assistance to another. Any difference in health outcomes across the two groups could be attributed to the higher incomes because this "treatment" was assigned randomly. However, this ideal experiment is unlikely to be implemented because the cost would be prohibitive. In lieu of an actual experiment, the basic idea behind the natural and quasi-experimental literature is to mimic the properties of random assignment trials but in field data. If in certain populations a portion of income (or education) is determined by a factor not reflective of underlying health, then it may be possible to trace out the health benefits of income (or education).

For example, economists have examined whether the increase in education generated by policies such as compulsory schooling (Adams 2002; Lleras-Muney 2005), an increase in access to colleges (Currie and Moretti 2003), and the Vietnam draft (de Walque 2007; Grimard and Parent 2007) have altered health outcomes. In these instances, education levels are increased by some external event, such as changes in state laws on compulsory education; the same group affected by the change in laws also experiencing improved health outcomes supports the conclusion that education and health are causally related. The papers listed all find improved health outcomes from greater education. However, recent work by Damon Clark and Heather Royer (2010) found that large changes in education produced

by an increase in compulsory education in the United Kingdom had no impact on adult mortality.

Similar work exploits variation in income produced by such external factors as winning the lottery (Lindahl 2005), German reunification (Fritters, Haisken-DeNew, and Shields 2005), receipt of an inheritance (Meer, Miller, and Rosen 2003), the expansion of food stamps (Almond, Hoynes, and Schanzenbach 2011; Currie and Moretti 2007), the expansion of the Earned Income Tax Credit (EITC; Evans and Garthwaite 2010), a drop in income in wine-growing regions caused by a phylloxera outbreak (Banerjee et al. 2007), conditional cash transfer programs and a rise in South African pensions (Case 2004), changes in Social Security payments (Snyder and Evans 2006), and permanent changes in cohort earnings brought about by technological shocks (Adda, von Gaudecker, and Banks 2009).

Using a lottery as a natural experiment is unique. Among lottery players, the probability of winning a large prize is solely a function of the amount of tickets purchased, and, as a result, winners are determined by chance. As long as the amount of lottery tickets does not reflect underlying health, winners and losers are therefore functionally randomly assigned. If following a ticket purchase winners have better health than losers, then the results indicate that among lottery players, income is protective of health.<sup>15</sup> In contrast to this work, results are mixed across the various types of natural experiments on the role that income plays in health: some find large benefits (from lottery winnings and South African pensions); some find no impact (from inheritances); and others find an increase in mortality from higher income (higher Social Security payments in the United States). The variance in the results for this literature is best illustrated by Jérôme Adda, Hans-Martin von Gaudecker, and James Banks (2009), who found that an increase in the permanent income for cohorts has no impact on self-reported health status or self-reported chronic conditions, but it increases smoking and reduced mortality.

Research in Mexico focusing on an experimental conditional cash transfer program called Progresa (now known as Oportunidades) found that increases in family income are tied to improvements in health. In this experiment, households received cash transfers if their children attended school or parents took children to medical providers to receive preventive care such as vaccinations. The findings of the experiment suggested that a doubling of the cumulative cash transfer was associated with a decrease in stunting (28.7 percent), a decrease in body mass index for age percentile, a lower prevalence of being overweight, and an increase in height for age. Based on the success of this program, related experiments are being tried elsewhere, including Harlem. Initial evaluation of the Harlem experiment (Opportunity NYC-Family Rewards) did not find a statistically significant

positive income effect on health or education and has been discontinued (for more on both programs, see Brett Fawley and Luciana Juvenal 2010).

The evidence from expansions of federal programs is also contradictory. Douglas Almond, Hilary Hoynes, and Diane Whitmore Schanzenbach (2011) found that expanding food stamps led to improvements in infant health through higher birth weights, lowered risk of low birth weight infants, and lower infant mortality. However, these results were not replicated when Janet Currie and Enrico Moretti (2008) studied the introduction of food stamps in California. William Evans and Craig Garthwaite (2010) exploit the 1993 expansions of the EITC to examine the impact of higher transfer payments on the health of low-income women and find that women most likely to receive higher payments as a result of the expansions have better self-reported physical and mental health plus smaller counts of risk levels of biomarkers.

Other studies make use of more unusual changes in policies or particular populations, such as the reunification of Germany on the health of those in the former East Germany and the influence of casino-based funds on the health of American Indians. These studies provide evidence that increases in income lead to improvements in health—and particularly mental health—but in general the effects are relatively small. The changes in health in these studies tend to be measured for short periods so leave open the question of whether any possible longer-term effects on health may be larger. The two studies on Native Americans that study the influence of increased income based on the initiation of casinos suggest the possibility of a greater influence on health, including mental health, when the income of an entire community is raised rather than only that of a single family (Costello et al. 2003; Wolfe et al. 2012). The first of these studies children over time in the Smoky Mountains and finds improvement in mental health for a subset of Native American children living on a reservation that acquires a casino during the period of study; the latter uses BRFSS data over about fifteen years to identify the influence of casinos on family income and through family income on health, health-related behaviors, and mental health days. In the latter study, income was tied to improvements in the majority of health measures and to some health-related behaviors and mental health measures. A unique study focuses on relative status within an already affluent population by examining mortality risk reduction as a result of winning an Academy Award versus being nominated but not selected. The win then is likely to produce higher future income as well as feelings of security and well-being. The findings of a 28 percent reduction in death rates for those winning an Oscar for best actor or actress suggest a considerably larger influence than that suggested by the other studies.<sup>16</sup> However, the effect was reversed for screen-

writers, which the researchers speculate may reflect the unique norms and culture of screenwriters (Redelmeier and Singh 2001b).

## CONCLUSION

The existence of an SES-health gradient is well established. The gradient appears in virtually all countries and across most if not all ages. However, the source of this gradient and hence the cause of major disparities in health is far less clear. Evidence using children certainly suggests that family income influences health, but the evidence from exogenous changes in income is far from clear. But perhaps most important, despite much work on the mechanisms that lie behind the gradient (see Adler and Stewart 2010), we cannot fully account for the observed disparities in health across income. Is it that higher incomes are used to purchase more health, yielding inputs such as better nutrition and housing? That better-educated persons use health care more effectively? That those in higher-prestige occupations face less risk? Or is it that stress and anxiety, tied to low incomes and job uncertainty, result in poor health?

No single explanation is likely to suffice. We hope that the following chapters provide insight into some of the potential mechanisms as well as a new approach to unlocking the black box in our knowledge of the SES-health gradient.

## NOTES

1. This claim appears most valid for minor health conditions; major disabilities might cause a parent to modify his or her work behavior, which would create a link from child health to family income. A child's health may also influence family wealth if additional resources are needed for the child. It is unclear whether, in industrialized nations, the prevalence of major disabilities among children is sufficiently high to account for the pervasive SES associations in the whole population.
2. The NHIS has a person sample where data for all household members are collected, then a sampled child survey where data for only one child per household are collected. Some of the outcomes of interest come from the sampled child survey; for these variables, sample sizes are substantially lower.
3. The other covariates include a set of dummy variables for age, race-ethnicity, gender, family size, family structure, and year of the survey.
4. Another way to characterize SES would be mother's or father's education, but these variables have a surprising number of missing observations, making them less attractive as covariates.

5. The first outcome is from a standard question asking respondents to rate their health as excellent, very good, good, fair, or poor. We use the bottom two categories. For the next two variables, we ask respondents how many bad mental health or bad physical health days they have had in the past thirty days. We define whether they have had any bad mental or physical days as the outcome of interest.
6. The other covariates include a quadratic term in age; a complete set of state, month, and year effects; plus dummies for gender, racial-ethnic group, and marital status.
7. We do this rather than use explicit income groups because the income variables are categorical responses that are in lumpy categories. With inflation over a twenty-year period, it is hard to define comparable real income levels over time.
8. Given the low three-year mortality rate in all three samples, the odds ratio can be considered a measure of the risk ratio.
9. The New Zealand finding is the result of high reported health among those in the lowest quintile and not lower health for both groups.
10. This survey begun in 2001 focuses on labor and income dynamics. At the time of this writing, the 2006 data were the latest data available. Data are available from the Melbourne Institute.
11. According to the National Center for Health Statistics (2009), 7 percent of children living in the community have a disability. Because not all of these children will influence parents' work behavior, this percentage is likely an overestimate of the potential endogeneity of parental work and children's health.
12. These findings are consistent with an interpretation that the prevalence of disease increases with age, and this greater variation allows more opportunities to detect disparities by family income.
13. Simon Condcliffe and Charles Link (2008), using the Medical Expenditure Panel Survey (MEPS) and the child supplement of the Panel Study of Income Dynamics, suggest that for the United States, lower-income children appear more likely to continue to suffer from a condition in subsequent years than children in higher-income families; however, that is in contrast to the findings of Currie and Stabile (2003) for Canada and Murasko (2008) for the United States, who both find no evidence that children in lower-income families fail to recover from an earlier condition. However, the studies are limited to the conditions collected by each dataset, so comparability and a full test have not been analyzed.
14. The Dunedin birth cohort is a longitudinal investigation of the health, development, and behavior of a birth cohort born April 1, 1972, and March 31, 1973, in Dunedin, a city of approximately 120,000 people on New Zealand's South Island. The data include perinatal information collected at delivery and data

collected at ages three, five, seven, nine, eleven, thirteen, fifteen, eighteen, twenty-one, twenty-six, and thirty-two. The latest sample size is 1972 (Danese et al. 2009).

15. There are still issues of selectivity with this study: first, it uses only lottery ticket buyers, who may be unique especially in terms of risk-taking; and two, lottery buyers who did not win are hard to identify and so the sample is incomplete.
16. Although this was the case for actors, a subsequent study of screenwriters did not show a difference. Perhaps the gain comes from broader esteem, and most of that seems directed to the generally better known group—actors and actresses. In another study of this sort, entrants into the Baseball Hall of Fame were studied, and the results showed that the longer they had to wait to be elected, the shorter their lifespan (Becker, Chay, and Swaminathan 2007).

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