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CHAPTER THREE

Socioeconomic Position and Health across Midlife

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Socioeconomic position is a powerful determinant of risk of death. There is ample evidence internationally for the relation between socioeconomic position and mortality (Adler and Ostrove 1999). There is much less evidence on its relation to measures of morbidity and of ability to function physically, psychologically, and socially. The MIDUS study of Americans at midlife provides the opportunity to examine the relation between socioeconomic position and measures of health and functioning. That MIDUS contains information from a range of domains pertinent to people's well-being allowed us to explore influences that may be responsible for the differences observed.

In this chapter we first summarize our initial analyses of the data from MIDUS that demonstrate the differences in health according to socioeconomic position. We then consider three additional questions that relate to health and to measures of functioning. First we ask whether the magnitude of the socioeconomic differences varies through the age range studied, 25–74. Second, we examine the predictive power of four different measures of socioeconomic position: education, household income, degree of poverty of the area of residence, and the Duncan socioeconomic index, which is based on educational attainment and income. If these measures are differently related to measures of health and functioning, the differences may convey information about potential causal pathways. Third, and related, we ask whether the different measures of socioeconomic position may relate differently to the potential mediating factors that we have identified.

Background: The Importance of the Social Gradient in Health

Research results have led to three important insights that lay the basis for the findings reported in this chapter. First, inequalities in health are important but they are not limited to worse health among the socially excluded. Second, they do not arise solely as the result of differential

provision and access to high-quality medical care. Third, the determinants of health, to a large extent, lie outside the medical sector. Research to understand these determinants and policies to influence them must therefore reach beyond the medical sector.

To take the first issue: social inequalities in health are now recognized to confront societies in important ways. They are on the agenda in the United States, the United Kingdom, the Netherlands, Sweden, Australia, and other countries, and the World Health Organization. In the United Kingdom, for example, the government set up an independent inquiry into inequalities in health, which reported in 1998 (Acheson 1998), eighteen years after the Black report (Townsend, Davidson, and Whitehead 1990). The statistical evidence reviewed by the independent inquiry and summarized in its report made clear that mortality and morbidity do indeed follow a social gradient. This was shown in the Whitehall studies. Among civil servants, position in the hierarchy was intimately related to risk of morbidity and mortality: higher status, lower risk (Marmot et al. 1984, 1991). The evidence does not show that there are simply health differentials between "them," the poor, and "us," the nonpoor. The poor are worse off, but among the nonpoor there is a social gradient in health and disease. Yet policy discussions commonly relate to how to improve the health status of "them" to make it more like the health status of "us." Many of the policy options put before the Independent Inquiry on Inequalities in Health dealt with poverty and strategies either to relieve poverty or to interrupt its link with ill health.

Discussions of policy options to reduce the social gradient in ill health are limited by the relative lack of understanding of the reasons why position in the hierarchy is intimately related to health risk. The MIDUS study offers further opportunity to contribute to understanding of determinants of the gradient in ill health.

The second issue relates to medical care. This is perhaps a more central discussion in the United States than it is in Europe because the differentials in access to medical care appear to be much more marked in the United States. The view summarized by the Independent Inquiry on Inequalities in Health (Acheson 1998) was that improvement of quality and access to medical care had an important part to play but that the causes of inequalities in health were primarily socioeconomic.

Both the first and second issues lead to the third: the causes of the social gradient in health lie outside the medical sector. If relative position in the hierarchy is important in addition to the effects of absolute deprivation, one must look to the social sciences for understanding of what that means

and what the social and psychological processes might be that link relative social position to health.

The MIDUS study was conducted by the MacArthur Foundation Research Network on Successful Midlife Development. A subgroup of that network came together around the issue of psychosocial factors and the social gradient in health (Marmot et al. 1997). This interdisciplinary group was responsible for collecting data in MIDUS across a greater range of aspects of social and psychological characteristics than is common in more medically oriented studies. The disciplinary breadth of the network, applied to the scientific problem of inequalities in health, contributed a rich array of intervening mechanisms. The scope of the sociodemographic and psychosocial variables across multiple domains in the MIDUS study means that MIDUS provides a good vehicle for examining potential contributors to the social gradient in health. Given that MIDUS was a cross-sectional study, it cannot provide the kind of answers to etiological questions that a cohort study could provide, but it can help point in the right direction.

A particular advantage of MIDUS is that it is based on a representative sample of the U.S. population. Much of the study of mechanisms underlying inequalities in health has, of necessity, been based on more restricted populations. These restricted populations will continue to be crucial because they are amenable to intensive data collection. A study of a wider national sample provides important complementary information.

Multiple Causes of the Social Gradient in Health: The MIDUS Study

In a previous report from MIDUS, we analyzed the relation of socioeconomic status to health, using education as a measure of socioeconomic status (Marmot et al. 1998). We analyzed three different measures of health, broadly defined. In the report, we used self-reported health because it has been employed in a number of different populations and is a predictor of mortality, in addition to being an overall summary measure of health. Respondents rated their present state of physical health on a five-point scale (1, poor; 5, excellent). The scale was dichotomized to poor/fair versus moderate/good/excellent health. Second, we examined waist–hip ratio. This measurement was chosen as a more objective marker of risk of physical disease. Respondents were provided with a tape measure, a diagram, and instructions on where and how to measure the waist and hip circumference. The waist–hip ratio is calculated by dividing

the waist circumference by the hip circumference; higher values indicate greater central adiposity. Central adiposity is related to development of diabetes and cardiovascular disease. Respondents in the top quintile were considered to be in the least favorable category, and this was taken as the health outcome. Third, we examined psychological well-being. This is not a measure of health in the usual sense but was included because it approaches the question of health as a positive attribute. Psychological well-being was measured with a composite score for six dimensions of positive psychological functioning (autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance). All three measures showed clear social gradients in health. Men and women who did not complete high school had worse health than did other groups. High school graduates were, in general, in worse health than were those with some college education, and persons who had completed college had the best health status.

We considered a number of factors that could potentially account for the link between educational status and health status: parents' education; neighborhood characteristics; smoking behavior; social relations, including marital status, support from family and friends, and a measure of strain among family and friends; decision authority and skill use in the workplace; perception of inequality; and control/efficacy, including measures of mastery and constraints. We asked if these could be mediators of the relation between socioeconomic status and health, in the sense of providing an account of why people of lower socioeconomic status have worse health. In most cases this is easily thought of as being in the causal chain; for example, people with lower education are more likely to smoke and thereby have worse health. Parental education does not lie on the causal chain in the same sense. Had it been the case that the relation between education and health could be accounted for by parents' education, the causal explanation might then have suggested that parental education might have been a "cause" of both low education and poor health.

Most of the variables listed were related to the three health outcome measures, but none taken alone provided the major explanation for the social gradient in health. Taken together, however, these variables had a substantial impact (table 1). Their importance in mediating the relation between socioeconomic status and health was assessed by computing the odds ratios of, for example, poor health in each educational group compared with the best-off group and then assessing the impact on the odds ratio of including these variables in a model. For self-reported health, for

TABLE 1 Relation of Educational Attainment and Three Health Outcome

	Women ($n = 1544$)			
	Model Adjusted for Age		Model Fully Adjusted[a]	
Variable	OR[b]	95% CI	OR[b]	95% CI
Poor/fair physical health				
Bachelor's or more	1.0		1.0	
Some college	2.63	(1.6–4.2)	1.84	(1.1–3.1)
High school	3.06	(1.9–4.9)	1.73	(1.0–3.0)
<High school	8.00	(4.7–13.5)	3.21	(1.7–6.0)
Waist–hip ratio (upper quintile)				
Bachelor's or more	1.0		1.0	
Some college	1.92	(1.3–2.9)	1.82	(1.2–2.8)
High school	1.63	(1.1–2.5)	1.40	(0.9–2.3)
<High school	3.03	(1.8–5.0)	2.33	(1.3–4.2)
Psychological well-being				
Bachelor's or more	1.0		1.0	
Some college	2.00	(1.3–3.1)	1.58	(0.9–2.7)
High school	3.41	(2.5–5.1)	2.79	(1.6–4.8)
<High school	5.91	(3.6–9.7)	3.07	(1.6–6.1)

Note: OR, odds ratio; CI, confidence intervals.

[a]Mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

[b]$N = 3032$. Results are unweighted and expressed as odds ratio, comparing each group with the most highly educated group.

example, men with less than a high school education had an odds ratio of 6.0 of reporting themselves to be in poor health. When the variables mentioned earlier were added to the model, the odds ratio was reduced to 3.3. For women the odds ratio was reduced from 8.0 to 3.2.

We were cautious in drawing too firm conclusions from a cross-sectional study, but our interpretation of these results was that a set of early and current life circumstances appears cumulatively to make a major contribution to explaining why people of lower socioeconomic status have worse health and lower psychological well-being.

SOCIOECONOMIC DIFFERENCES IN HEALTH IN MIDLIFE: EFFECTS OF AGE AND MEASURES OF SOCIOECONOMIC STATUS

Effects of Age

It has been suggested (West 1988) that during young adulthood, social inequalities in health are of lesser magnitude than they are in older

Measures in the MIDUS National Sample

Men ($n = 1461$)			
Model Adjusted for Age		Model Fully Adjusted[a]	
OR[b]	95% CI	OR[b]	95% CI
1.0		1.0	
2.07	(1.2–3.2)	1.67	(1.0–2.7)
2.47	(1.6–3.8)	1.71	(1.0–2.8)
5.96	(3.6–9.8)	3.25	(1.8–5.9)
1.0		1.0	
1.28	(0.9–1.9)	1.15	(0.8–1.7)
1.96	(1.4–2.8)	1.70	(1.1–2.6)
2.16	(1.3–3.6)	1.47	(0.8–2.6)
1.0		1.0	
1.83	(1.3–2.7)	1.56	(1.0–2.5)
2.44	(1.7–3.5)	2.22	(1.3–3.7)
4.83	(3.0–7.6)	3.81	(2.0–7.3)

age groups. At old age, social inequalities may again be narrower in relative terms. In the first Whitehall study of British civil servants, relative differences among employment grades in mortality were less after than before retirement (Marmot and Shipley 1996). The absolute differences in mortality were greater, however, because mortality rates are higher at older ages.

There are at least three ways to view these findings. First, the lack of health inequalities at a young age may be, in part, that in such healthy groups there is little serious ill health, and therefore, little health inequalities. Second, if accumulation of disadvantage continued throughout life, one might expect health inequalities to grow wider with age. Third, if age were a leveler and the ravages of time caught up with all regardless of socioeconomic position, health inequalities might be expected to narrow in later life.

It is therefore of interest to compare the magnitude of socioeconomic differences in a number of measures of morbidity at different ages during the age period 25–74 years covered by the MIDUS sample. As an alternative, in what amounts to the same analyses in these cross-sectional data, we can examine the age trajectory of measures of morbidity during the midlife period among different socioeconomic groups.

TABLE 2 Mean Scores or Proportions of Health

	Women			
Age (years)	25–39	40–59	60–74	Interaction
Waist–hip ratio				
≥Bachelor's	0.78	0.79	0.82	
Some college	0.82	0.82	0.86	
High school	0.83	0.82	0.86	
<High school	0.84	0.86	0.88	
Linear trend in education	0.006	0.0001	0.06	>0.25
SF-36				
≥Bachelor's	91.1	86.1	74.0	
Some college	87.0	80.2	69.9	
High school	83.2	76.0	67.7	
<High school	68.0	67.3	56.2	
Linear trend in education	0.0001	0.0001	0.0002	>0.25
Poor/fair physical health				
≥Bachelor's	5.0	7.2	10.0	
Some college	16.9	15.1	15.5	
High school	13.5	17.7	24.8	
<High school	20.0	42.6	47.3	
Linear trend in education	0.02	0.001	0.001	0.22
Depression				
≥Bachelor's	15.7	17.0	10.0	
Some college	22.9	18.1	5.2	
High school	25.0	13.2	10.5	
<High school	46.7	18.5	16.2	
Linear trend in education	0.001	n.s.	0.06	0.02

Note: Interaction = *p*-value for test of differences in slope between age groups.

These are shown, using education as the measure of socioeconomic status, in table 2. We have included two further dependent variables to those outlined earlier—the physical health functioning component of the SF-36 (a health status measure) and depression. The physical functioning component of the SF-36 consisted of nine items asking respondents about vigorous and moderate activities as well as items on ability to walk, bathe, and dress oneself. The scores ranged from 0, indicating severe limitation in performing all physical activities, to 100, indicating no limitation. Depression was defined as a diagnosis during the preceding twelve months of a major depressive episode, based on the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders,* revised third edition (DSM-111-R). The respondents were assessed for depression during the telephone interview by use of the World Health

Outcomes by Education and Age Group

Men			
25–39	40–59	60–74	Interaction
0.93	0.95	0.95	
0.94	0.94	0.99	
0.94	0.99	0.97	
0.95	0.98	0.97	
0.38	0.004	0.007	0.04
93.8	89.5	82.3	
89.6	85.2	75.3	
90.5	80.5	76.6	
86.2	73.7	67.7	
0.02	0.0001	0.003	0.08
6.2	5.3	13.8	
8.2	14.5	25.0	
7.9	18.8	23.5	
31.3	36.8	37.0	
0.003	0.001	0.004	0.15
12.4	9.7	3.2	
13.5	14.5	7.8	
11.9	8.5	5.9	
18.8	15.8	6.5	
n.s.	n.s.	n.s.	>0.25

Organization's composite international diagnostic interview–short form (WHO CIDI-SF), and they were classified as yes/no.

Table 2 shows no strong support for a difference in the steepness of the social gradient by age among men or women. There is, at most, some suggestion that the social gradient in the physical health dimension of the SF-36 is wider for those in the 40–59 age span than it is for those in the 23–39 span. Looked at the other way, there is, perhaps, greater deterioration with age in the SF-36 physical health score among men with least education compared to those with most. Among women, depression decreases with age, and the social gradient diminishes. The interaction between education and age is significant.

Measures of Socioeconomic Status

The next question concerns the degree to which different socioeconomic indicators relate differently to the health outcomes. In particular,

are there gender differences in the size of association? In the past the question of whether one socioeconomic measure might predict ill health better than another was seen largely as a pragmatic empirical question. To epidemiologists, more remarkable than differences among different measures of social position was that they all predicted mortality. Epidemiologists recognized that different socioeconomic measures had particular properties that made them useful. For example, work-based measures of social class are not useful for looking at persons not in the formal work force, such as housewives and older people (Goldblatt 1990). A household measure, or education, might be expected to be more related to social position for such people than occupation.

This is the perspective we take in this chapter. We have used four measure of socioeconomic position. They are, of course, correlated, but they are derived differently and serve different purposes. Two of the measures relate to the individual: educational attainment categorized into four categories from highest to lowest, and the Duncan socioeconomic index, which is based on educational attainment and income to predict occupational prestige. This index is divided into quartiles from lowest to highest (Duncan 1961; Hauser and Watten 1997). The third measure relates to the individual's household circumstances, household income, again divided into quartiles; the fourth relates not to an individual's own characteristics but to where that person lives. This measure classifies households on a poverty index according to their location by use of census information and is a combination of the proportion of households in the zip code that are below the poverty line and the proportion of unemployed persons residing in the area. This area-based measure relates to the debate in the literature about whether there are characteristics of places that predict health of residents over and above the characteristics of individuals who reside there (McIntyre and Ellaway 2000).

Lately, Bartley has pointed out that different measures of socioeconomic position have different theoretical bases and may therefore convey different information (Bartley and Marmot 2000). A measure based on work, if developed appropriately, might reflect power relations in the work place. One based on general social standing might relate more closely to lifestyle. In our analyses (see tables 7–10), we seek evidence of different pathways linking a measure of socioeconomic position to ill health.

Tables 3 and 4 show odds ratios of the four adverse health outcomes for the four socioeconomic indices. Because there were no large differences

by age in the size of the association with socioeconomic status for any of the socioeconomic indices, subsequent analyses are shown for all ages adjusted for age.

In general, all four measures were associated with the four health outcomes (tables 3 and 4). For women, education appears to have a stronger relation with self-reported health and the physical component of the SF-36; the poverty index of the area and the Duncan socioeconomic index were not related to depression. In men there were no clear differences in odds ratios of having an adverse health outcome among the four socioeconomic measures.

It is useful when comparing different levels of an exposure to express the magnitude of effects relative to a baseline level. The odds ratio is one such measure, and usually the most favorable level of the exposure is taken as the baseline group. This group therefore has an odds ratio equal to 1.0, and more adverse levels of the exposure with respect to the outcome have odds ratios greater than 1.0. Thus, women who did not complete high school have 8.5 times the odds of being in poor health compared with women who completed a college education. These categories relate to readily comprehensible features of social reality. When it comes to comparing the predictive power of different measures, however, the problem arises that the distribution of the population among categories differs for the different socioeconomic measures. For example, 10.4 percent of women are in the lowest educational category, whereas approximately 30 percent of women are in the lowest household-income category and 29 percent in the highest area-of-poverty category. Therefore, in comparing predictive power of different socioeconomic measures, we are not comparing similar proportions of the population, and we might expect more extreme groups to show larger effects.

This problem was addressed in relation to time trends in social inequalities (Pamuk 1985) and in relation to international comparisons (Kunst 1997), where the same issue arises of wishing to compare similar proportions of populations. The approach taken is to use the relative index of inequality (RII) (Pamuk 1985; Mackenbach and Kunst 1997). To make fair comparisons, we score each socioeconomic measure from 0 to 1. Individual scores are assigned according to the proportion of persons who fall into a particular category. To illustrate, we place all individuals in one of four educational groups, depending on each person's educational level, ranging from less than high school to a bachelor's degree or more. For purposes of illustration, we assume

TABLE 3 Odds Ratio of Women's Adverse Health Outcomes

	Waist–Hip Ratio (worst quintile)		SF-36 (worst quintile)	
Variable	OR	95% CI	OR	95% CI
Education				
Bachelor's or more	1.0		1.0	
Some college	1.90	(1.3–2.8)	1.78	(1.2–2.6)
High school	1.61	(1.1–2.4)	2.30	(1.6–3.3)
<High school	3.21	(2.0–5.2)	5.85	(3.7–9.2)
Education RII	2.62	(1.6–4.4)	5.98	(3.7–9.7)
Household income				
Highest quartile	1.0		1.0	
Second quartile	1.86	(1.1–3.0)	1.11	(0.7–1.7)
Third quartile	1.73	(1.1–2.8)	1.37	(0.9–2.0)
Lowest quartile	3.05	(1.9–4.8)	2.74	(1.9–4.0)
Income RII	3.57	(2.1–6.1)	4.27	(2.7–6.8)
Poverty index				
Low poverty	1.0		1.0	
Intermediate	1.61	(1.1–2.3)	1.51	(1.1–21)
High poverty	1.94	(1.3–2.9)	2.14	(1.5–3.0)
Poverty RII	2.45	(1.5–4.2)	2.89	(1.8–4.6)
Duncan socioeconomic index				
Highest quartile	1.0		1.0	
Second quartile	1.18	(0.8–1.8)	1.80	(1.2–2.7)
Third quartile	0.80	(0.5–1.2)	1.21	(0.8–1.8)
Lowest quartile	1.85	(1.3–2.7)	2.41	(1.7–3.5)
Duncan RII	2.31	(1.4–3.8)	2.76	(1.8–4.3)
All four indices[a]				
Education RII	1.45	(0.8–2.8)	4.19	(2.3–7.5)
Income RII	2.55	(1.5–4.5)	2.75	(1.7–4.5)
Poverty RII	1.75	(1.0–3.0)	1.74	(1.1–2.8)
Duncan RII	1.39	(0.8–2.5)	0.97	(0.6–1.6)

Note: OR, odds ratio; CI, confidence interval.
[a]Adjusted for each other.

that 25 percent are in each group. The cut points along the 0–1 scale would then be 0.25, 0.5, and 0.75. Everyone in the lowest group would be assigned the midpoint of that group, that is, 0.125. Everyone with a high school education would be assigned the score corresponding to the midpoint of the next group, that is, 0.375; those with some college would be given the score 0.625; and those with a bachelor's degree, 0.875. Hence, the cut points are assigned according to the proportions in each category, and the scores are given by the midpoints of each category. These assignments are repeated within age strata to remove age

by Category of Socioeconomic Measure (adjusted for age only)

Poor/Fair Health		Depression Diagnosis	
OR	95% CI	OR	95% CI
1.0		1.0	
2.60	(1.6–4.2)	1.16	(0.8–1.7)
3.01	(1.9–4.8)	1.13	(0.8–1.6)
8.48	(5.0–14.3)	2.12	(1.3–3.4)
8.17	(4.7–14.2)	1.75	(1.15–2.9)
1.0		1.0	
1.31	(0.8–2.1)	0.91	(0.6–1.4)
1.48	(0.9–2.3)	1.08	(0.7–1.7)
2.42	(1.6–3.7)	1.61	(1.1–2.4)
3.25	(1.9–5.5)	2.16	(1.3–3.6)
1.0		1.0	
1.60	(1.1–2.3)	1.24	(0.9–1.7)
2.29	(1.6–3.4)	1.03	(0.7–1.5)
3.16	(1.9–5.3)	1.04	(0.6–1.7)
1.0		1.0	
2.06	(1.3–3.4)	0.97	(0.6–1.5)
1.81	(1.1–2.9)	1.26	(0.9–1.8)
3.35	(2.7–5.2)	1.07	(0.7–1.6)
4.38	(2.7–7.3)	1.18	(0.7–1.9)
4.71	(2.4–9.1)	1.92	(1.0–3.6)
1.75	(1.00–3.1)	2.18	(1.2–3.8)
1.87	(1.1–3.2)	0.82	(0.5–1.4)
1.64	(0.9–3.0)	0.70	(0.4–1.2)

effects. The logistic regression model provides odds ratios for the notional top (1) and bottom (0) of the socioeconomic hierarchy. The effect is to measure the degree of inequality after taking account of the distribution of the socioeconomic variable. The odds ratio computed by using the RII is bigger than the odds ratios observed for the actual categories, provided that these odds ratios are increasing smoothly. This is because the RII represents notional individuals at the extremes, rather than those in real groups such as those with a bachelor's degree or those with less than a high school education. This "inflated" estimate of

TABLE 4 Odds Ratio of Men's Adverse Health Outcomes by

Variable	Waist–Hip Ratio (worst quintile) OR	95% CI	SF-36 (worst quintile) OR	95% CI
Education				
Bachelor's or more	1.0		1.0	
Some college	1.27	(0.9–1.9)	1.81	(1.2–2.8)
High school	1.98	(1.4–2.8)	2.11	(1.4–3.2)
<High school	2.10	(1.3–3.4)	3.86	(2.4–6.3)
Education RII	2.86	(1.7–4.7)	4.17	(2.4–7.1)
Household income				
Highest quartile	1.0		1.0	
Second quartile	1.38	(0.9–2.0)	1.63	(1.0–2.5)
Third quartile	1.63	(1.1–2.4)	2.04	(1.3–3.2)
Lowest quartile	1.51	(1.0–2.2)	3.87	(2.5–5.9)
Income RII	1.79	(1.1–2.9)	5.62	(3.3–9.6)
Poverty index				
Low poverty	1.0		1.0	
Intermediate	1.07	(0.8–1.5)	1.28	(0.9–1.9)
High poverty	1.29	(0.9–1.9)	2.32	(1.5–3.5)
Poverty RII	1.43	(0.8–2.4)	3.47	(1.9–6.2)
Duncan socioeconomic index				
Highest quartile	1.0		1.0	
Second quartile	0.89	(0.6–1.3)	1.10	(0.7–1.7)
Third quartile	1.58	(1.1–2.3)	1.55	(1.0–2.4)
Lowest quartile	1.31	(0.9–2.0)	2.03	(1.3–3.1)
Duncan RII	1.84	(1.1–3.0)	3.05	(1.8–5.3)
All four indices[a]				
Education RII	2.69	(1.5–5.0)	2.55	(1.3–4.9)
Income RII	1.31	(0.8–2.3)	3.73	(2.1–6.7)
Poverty RII	1.12	(0.6–2.0)	2.24	(1.2–4.1)
Duncan RII	0.92	(0.5–1.7)	0.94	(0.5–1.9)

Note: OR, odds ratio; CI, confidence level.
[a]Adjusted for each other.

inequalities in health should not bias the comparison among socioeconomic indicators.

Using the RII to compare predictive power of the different socioeconomic measures confirms the findings with the odds ratios: among women, education appears to have greater predictive power for self-reported health and SF-36; poverty of the area and the Duncan socioeconomic index are less predictive of depression. Among men, the RII confirms the lack of predictive power of education on depression and the ability of the other indices to predict in "bivariate" analyses, that is, adjusting only for age.

Category of Socioeconomic Measure (adjusted for age only)

Poor/Fair Health		Depression Diagnosis	
OR	95% CI	OR	95% CI
1.0		1.0	
2.07	(1.3–3.2)	1.40	(0.9–2.1)
2.49	(1.6–3.8)	0.97	(0.6–1.5)
6.11	(3.7–10.0)	1.69	(0.9–3.0)
6.54	(3.8–11.3)	1.29	(0.7–2.4)
1.0		1.0	
1.64	(1.0–2.6)	0.72	(0.4–1.2)
2.65	(1.7–2.1)	1.43	(0.9–2.3)
4.31	(2.8–6.6)	2.29	(1.5–3.6)
6.97	(4.0–12.0)	3.58	(1.9–6.5)
1.0		1.0	
1.23	(0.8–1.8)	1.13	(0.7–1.7)
2.06	(1.4–3.1)	1.38	(0.9–2.2)
2.90	(1.6–5.1)	1.58	(0.8–3.0)
1.0		1.0	
0.95	(0.6–1.5)	0.81	(0.5–1.3)
2.18	(1.4–3.4)	0.98	(0.6–1.6)
3.63	(2.3–5.6)	1.39	(0.9–2.2)
6.66	(3.79–11.8)	1.79	(1.0–3.3)
2.74	(1.4–5.3)	0.74	(0.3–1.5)
3.77	(2.1–6.8)	3.43	(1.8–6.6)
1.52	(0.8–2.8)	1.16	(0.6–2.3)
2.16	(1.1–4.3)	1.35	(0.6–2.8)

Poverty or Inequality

One of the important debates in the field of inequalities in health is the degree to which these inequalities can be explained by material differences between socioeconomic groups. Thus, if those with the lowest incomes have the worst health, this could be attributed to their disadvantaged material circumstances, which could relate to inadequate nutrition and worse housing, with damp, inadequate heating and crowding. These data show that those with lowest household incomes have highest risk of ill health, but they also show a gradient. In general, those in the second highest income quartile have worse health outcomes than do those in the highest.

TABLE 5 Relative Index of Inequality for Measures of

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
Education	2.62	(1.56–4.4)	1.85	(1.0–3.5)
Household income	3.57	(2.1–6.0)	2.24	(1.4–4.3)
Poverty index	2.45	(1.4–4.2)	1.63	(0.9–2.9)
Duncan socioeconomic index	2.31	(1.4–3.8)	1.51	(0.9–2.6)

Note: CI, confidence intervals.

[a]Mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

Interpreting Analyses of Multiple Socioeconomic Indicators

At the bottom of tables 3 and 4, the RIIs have been entered in a model together. One should be wary of overinterpretation of these multivariate analyses. These four socioeconomic measures are all correlated. Hence, when all four are put into a model together, what happens to the size of the measure of effect may have as much to do with precision of the socioeconomic measurement as with the substantive importance of the concept that the measure is addressing. That, however, is a general problem, and one might have expected that it would apply more or less equally to the four health outcomes.

In women, the impression that education is most strongly related to self-reported health and SF-36 is confirmed when all four socioeconomic measures are in the model. In men, education is related strongly to these two outcomes, although not more strongly than is household income. With the other indices in the model, the Duncan socioeconomic index has no extra predictive power in women and retains it in men only for those with poor self-reported health.

Exploring the Links between Socioeconomic Status and Ill Health

In our previous analyses of the relation between education and health outcomes, we showed that no one factor accounted for the observed associations but that a combination of measures appeared to make a contribution (Marmot et al. 1998). In the present analyses, we wished to investigate the possibility that different measures of social position might be related to health outcomes through different pathways.

Socioeconomic Status, for Waist–Hip Ratio in Men and Women

Men			
Age Only		Adjusted for Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
2.86	(1.7–4.7)	2.12	(1.2–3.8)
1.79	(1.1–2.9)	1.27	(0.7–2.2)
1.43	(0.8–2.4)	1.30	(0.7–2.2)
1.84	(1.1–3.1)	1.14	(0.6–2.0)

Statistical models of the relation between social position and health were therefore constructed that, in addition to age and race, included the following variables: mother's education, father's education, job characteristics of decision authority and use of skills, smoking, and degree of mastery and constraints in various aspects of life. Variables were included in a model if they changed the association between socioeconomic indicator and ill health by 5 percent or more. The results of these analyses are shown for the four health outcomes in tables 5–8. It is worth emphasizing that the same set of potential explanatory variables was included for each measure of social position. The aim was to assess whether different variables from among the whole group would be linked to different socioeconomic measures and hence suggest a different pathway of action.

Parents' education was included as a marker of social circumstances in which the individual was raised. Father's or mother's education enters into most of the models, suggesting that social background may, to some extent, be a determinant of health in adulthood and that it may account for some of the relation between markers of adult socioeconomic position and ill health. The fact that the relation of adult position to ill health remains, for the most part, significant after adjustment for parents' education suggests that factors from early life may not be the main determinants of the social gradient in health seen in adulthood. We had shown previously that in relation to self-reported health in MIDUS participants, mother's education was more strongly related to ill health in women, father's education to ill health in men (Marmot et al. 1998). No clear distinction is seen in these analyses, although for men, father's education enters into models as a mediator of the gradient in health more often than does mother's education.

Psychosocial factors appear also to be involved in the mediation of the relation between social position and ill health. Two classes of factors

TABLE 6 Relative Index of Inequality for Measures of

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
Education	5.98	(3.7–9.7)	3.42	(1.9–6.1)
Household income	4.27	(2.7–6.8)	2.65	(1.6–4.4)
Poverty index	2.89	(1.8–4.6)	1.75	(1.0–2.9)
Duncan socioeconomic index	2.76	(1.8–4.3)	1.38	(0.8–2.3)

Note: CI, confidence intervals.

[a]Mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

TABLE 7 Relative Index of Inequality for Measures of

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
Education	8.17	(4.7–14.2)	3.18	(1.6–6.2)
Household income	3.25	(1.9–5.5)	1.62	(0.9–2.9)
Poverty index	3.16	(1.8–5.3)	1.84	(1.0–3.3)
Duncan socioeconomic index	4.38	(2.6–7.3)	1.79	(1.0–3.2)

Note: CI, confidence intervals.

[a]Mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

were considered here—related to work and to other aspects of life. Both of these relate to the degree to which individuals have the opportunity to control their environment and the degree to which they feel they have mastery over it. The issue of feeling in control is explored in greater detail in chapter 11 of this volume, by Lachman and Firth. It is a matter of concern that the relation between psychosocial factors and self-reported measures of ill health could represent biased reporting: there could be a plaintive set toward negative reporting. The fact that these psychosocial factors were related also to waist–hip ratio is less easy to explain as biased reporting and makes it more likely that the observed relationships are not artifactual.

Socioeconomic Status, for SF-36 in Men and Women

Men			
		Adjusted for	
Age Only		Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
4.17	(2.4–7.1)	2.27	(1.2–4.3)
5.62	(3.3–9.6)	2.77	(1.5–5.0)
3.47	(1.9–6.2)	2.26	(1.2–4.2)
3.05	(1.7–5.3)	1.44	(0.7–2.7)

Socioeconomic Status, for Fair/Poor Health in Men and Women

Men			
		Adjusted for	
Age Only		Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
6.54	(3.8–11.3)	3.76	(2.0–7.2)
6.97	(4.0–12.0)	3.69	(2.0–6.7)
2.90	(1.6–5.1)	2.27	(1.2–4.2)
6.66	(3.8–11.7)	3.54	(1.9–6.7)

Not surprisingly, smoking appears to play a role in explaining the social gradient. Smoking may be present in these models both because of its own important role and because it is correlated with other health behaviors.

These analyses, shown in tables 5–8, indicate that the factors considered do appear to play some role in linking measures of social circumstances or social position to ill health. For each of these analyses we explored whether different mediators played a role in accounting for the relation between socioeconomic measure and health. No clearly different picture emerged. The mediators were more or less the same for each socioeconomic measure. The analyses shown use the same set of mediators for each table.

Interaction with Psychological Well-Being

We had previously treated psychological well-being as an "outcome," albeit one representing positive health rather than ill health. It too showed

TABLE 8 Relative Index of Inequality for Measures of

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
Education	1.75	(1.0–2.9)	1.03	(0.5–1.9)
Household income	2.16	(1.3–3.6)	1.59	(0.9–2.8)
Poverty index	1.04	(0.6–1.7)	0.93	(0.5–1.6)
Duncan socioeconomic index	1.18	(0.7–1.9)	0.72	(0.4–1.2)

Note: CI, confidence intervals.
[a]Mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

TABLE 9 Relationship between Waist–Hip Ratio and SF-36, and

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
WHR–low PWB	2.02	(1.0–4.1)	1.52	(0.6–3.6)
WHR–high PWB	2.51	(1.1–5.6)	2.41	(0.9–6.5)
SF-36–low PWB	4.86	(2.5–9.2)	4.92	(2.2–10.8)
SF-36–high PWB	4.51	(2.1–9.8)	2.56	(1.0–6.7)

Notes: CI, confidence interval; WHR, waist–hip ratio; PWB, psychological well-being.
[a]Mediators: early childhood environment as measured by mother's and father's education: psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

a social gradient: people of higher education scored better on the measure of psychological well-being. Ryff has proposed (Ryff and Keyes 1995) that well-being may act to protect individuals from breakdown in the face of adverse circumstances. Given the strong relation of socioeconomic position to ill health, we examined the relation of two of the measures of social position, education and household income, to two of the health outcomes, waist–hip ratio and SF-36 physical health, with the population further stratified as either above or below the median on psychological well-being. It seems reasonable to assume that low household income will be associated with adverse circumstances. Low education may be a measure not only of adverse circumstances but also of ability to cope.

Socioeconomic Status, for Depression in Men and Women

Men			
Adjusted for			
Age Only		Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
1.29	(0.7–2.4)	0.59	(0.3–1.2)
3.58	(1.9–6.5)	2.07	(1.0–4.1)
1.58	(0.8–3.0)	1.27	(0.6–1.9)
1.79	(1.0–3.3)	0.94	(0.5–1.9)

Education Stratified by Psychological Well-Being and Gender

Men			
Adjusted for			
Age Only		Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
3.50	(1.7–7.0)	2.17	(0.9–5.1)
2.17	(1.1–4.4)	2.08	(0.9–4.8)
4.99	(2.5–10.0)	2.16	(0.9–5.1)
2.04	(0.8–4.9)	1.96	(0.7–5.7)

When education is the marker of social position (table 9), there is little evidence of interaction. There is some evidence of interaction between income and psychological well-being in relation to waist–hip ratio and physical functioning (table 10). With high psychological well-being, the relation of household income to the two endpoints is weaker than when psychological well-being is low, and in most cases loses statistical significance.

Discussion

These analyses from a national sample of Americans confirm the general finding that health follows a social gradient. This is seen particularly clearly in table 4: among men, for each of the four indicators of ill health, the lower the position in the social hierarchy, the higher the risk. The RII represents the slope of the relationship between socioeconomic status and ill health. Hence, the confidence intervals around the RII are roughly

TABLE 10 Relationship between Waist–Hip Ratio and SF-36, and

	Women			
	Adjusted for			
	Age Only		Age, Race, and Mediators[a]	
	RII	95% CI	RII	95% CI
WHR–low PWB	5.36	(2.6–11.2)	3.53	(1.6–7.2)
WHR–high PWB	1.98	(0.9–4.4)	1.75	(0.7–4.1)
SF-36–low PWB	6.54	(3.5–12.3)	4.73	(2.4–9.3)
SF-36–high PWB	1.55	(0.7–3.3)	0.87	(0.4–2.0)

Notes: CI, confidence interval; WHR, waist–hip ratio; PWB, psychological well-being.
[a]Mediators: early childhood environment as measured by mother's and father's education: psychosocial work environment, measured by job characteristics of decision authority and use of skills; health behavior, measured by smoking; and degree of mastery and constraints in various aspects of life.

equivalent to a test of trend. Among women, the RIIs are, in general, significantly different from 1.0, although inspection of the odds ratios shows the social gradient somewhat less clearly.

One of the questions addressed by the present analyses was possible differences in health inequalities by age. In the first Whitehall study, relative inequalities in mortality were smaller at older rather than younger ages (Marmot and Shipley 1996), and epidemiological studies of coronary heart disease show some decline in the predictive power of risk factors in this age range (Shipley, Pocock, and Marmot 1991). Putting this information together with the suggestion that inequalities in health are relatively narrow during the adolescent years led to the speculation that health inequalities might be largest in midlife. In this study, there was little evidence for difference by age in the slope in inequalities for people aged 25–74. Perhaps this age range does not provide an adequate test of the hypothesis because it excludes both adolescents and persons older than 75. Nevertheless, given the coronary heart disease experience, had there been a change in the slope of health inequalities, one might have expected to see it in this age range.

One tentative conclusion from these analyses, therefore, is that social inequalities in health do not vary greatly over the 25-to-74-year age span. This would be consistent with social circumstances affecting the health outcomes considered here, with little lag time between cause and effect.

The second issue that we addressed is the relative power of different socioeconomic indices to predict markers of ill health in men and women. We have raised three types of doubts about comparisons of size of effect,

Income Stratified by Psychological Well-Being and Gender

Men			
Adjusted for			
Age Only		Age, Race, and Mediators[a]	
RII	95% CI	RII	95% CI
2.10	(1.1–4.1)	1.59	(0.8–3.3)
1.26	(0.6–2.7)	0.84	(0.4–2.0)
5.05	(2.5–10.0)	2.41	(1.1–5.1)
3.40	(1.3–8.6)	2.75	(1.0–7.8)

and all three relate to problems of measurement. First, when comparing different socioeconomic indices, we are in general comparing groups of different sizes. Thus, for example, 10.4 percent of women are in the lowest educational category (less than high school), whereas, 29 percent are in the highest poverty area. To correct for this problem we used the RII that can be interpreted as the odds ratio of lowest versus highest group, standardizing for the size of the groups. Measurement imprecision leads to the other two sources of doubt. One variable may appear to be more closely related to the outcome by virtue of its greater precision (and validity). Further, when several socioeconomic variables are entered into one multivariate model, one must be cautious with the interpretation of the resultant odds ratios.

With these caveats in mind, we note that education was a consistent predictor of all four health outcomes in women, and in men for all but depression. In nearly all the models that included all four socioeconomic indices, education remained a significant predictor of ill health. This relates first to the important question of health selection or reverse causation. The thrust of our analyses is based on the assumption that socioeconomic position is a determinant of ill health, rather than ill health being a prime determinant of socioeconomic position. In cross-sectional data, both directions are plausible, where socioeconomic position is measured by, for example, income. Ill health could lead to deterioration of income. It is less plausible where socioeconomic position is measured by education. It is of course possible that ill health in childhood could affect educational achievement. Where it has been studied, however, this is a minor effect (Wadsworth 1986). A more likely interpretation is that education is a measure of socioeconomic position that precedes the development of ill health. The observed relation cannot, therefore, be explained primarily by health selection.

The results further show that after taking education into account, other indices are still predictive of ill health. Household income, as an obvious marker of financial circumstances, is related to all measures of ill health in women and to all but waist–hip ratio in men. Despite the correlation between education and income, the fact that income has an independent relation with health is evidence for the effect of current social circumstances on health. For men, particularly, income shows the social gradient effect on health. Men in the worst quartile of household income have worse health than those in the top quartile, but those in the third quartile also have worse health than those in the top quartile. The significance of the RII is therefore not driven only by worse health for those at the bottom but also by a social gradient that runs across society. It is this that has given rise to the hypothesis that it is inequality rather than lack of material well-being that contributes to the gradient in health (Wilkinson 1996; Wadsworth 1986).

These analyses also show an area effect. There has been debate over the extent to which characteristics of areas may contribute to health over and above the characteristics of individuals who live in those areas—the so-called contextual as against compositional effects (Diez-Roux 1998). This has policy relevance. If apparently unhealthy areas are unhealthy because of the degree of deprivation of their residents, that conclusion has different policy implications than if an area is unhealthy because of characteristics of the area itself, such as transport, amenities, the quality of housing, or because of characteristics of the social environment such as social capital. These data are consistent with an area effect on health, more consistently seen in women, after the effect of education, household income, and the Duncan socioeconomic index have all been taken into account.

One of the stimuli for this further analysis of MIDUS data was the question of whether different socioeconomic indices would have different predictive power in men and women. The gender differences were not striking. Comparison of the bivariate and multivariate models in tables 3 and 4 suggests that much, but not all, of the strong predictive effect of education in both men and women is taken up by measures of current socioeconomic status. This is consistent with a hypothesis that part of the reason for the link between education and health is that education is a route into social circumstances in adult life. A plausible interpretation of these data, therefore, is that part of the reason people with less education have worse health is not because of their education level per se, but because

they have less attractive jobs, have lower household incomes, and live in poorer areas.

Women's education shows a lower correlation with household income than does men's. Under these circumstances, the fact that, in multivariate models, education looks marginally stronger than household income as a predictor in women, and marginally less strong in men, is consistent with not all of the education effect being the result of current social circumstances.

We reported previously (Marmot et al. 1998) from these MIDUS data that no single factor explained the majority of the social gradient in health. Here we explored the hypothesis that different socioeconomic measures may have different pathways of action in their effect on health. We examined four domains as potential mediators: early childhood environment as measured by mother's and father's education; psychosocial work environment, as measured by job characteristics of decision authority and use of skills; health behavior, as measured by smoking; and degree of mastery and constraints in various aspects of life. A combination of these factors appeared to account for some of the social gradient in health. We did not, however, detect a difference among our four socioeconomic indices in the degree to which different variables appeared to mediate the relationship with health.

There is abundant evidence on the social gradient in mortality but much less on differences in morbidity. These analyses show that for a number of health outcomes, there is a clear social gradient in women, as in men. In the age range studied here, 25–74, there is no difference by age in the slope of the gradient. Although it is hazardous to draw firm conclusions from a cross-sectional study such as this, the analyses are consistent with some persisting effect of childhood circumstances on adult health, as shown by the independent relation to these health outcomes. The analyses also show, however, that social circumstances of adults are related to ill health, independent of education and mother's and father's education. These results are consistent with the view that in order to reduce inequalities in health, it is necessary to improve the quality of localities as well as to pay attention to the individuals who live and work in those areas (Acheson 1998).

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