The Rising Significance of Education for Health?

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Research on inequality in America shows evidence of a growing social and economic divide between college graduates and people without college degrees. This article examines whether disparities in health between education groups have also recently increased. Pooled cross-sectional regression analyses of data from the National Health Interview Survey (NHIS) show that educational disparities in self-reported health status increased from 1982 to 2004 among older adults but held relatively steady or narrowed among younger adults. Sensitivity analyses show that the trends do not totally or primarily reflect change in the demographic composition of education groups. The trend of increasing disparities among older adults might reflect large and growing educational disparities in economic resources, health-promoting behaviors, or the use of health services and medical technology.

The last two decades of the 20th century saw a sharp upswing in levels of social and economic inequality in the United States. As predicted by Bell (1973) and other social theorists, much of this trend reflects increasing inequality on the basis of education levels, particularly between college-educated men and women and those without college degrees. Increasing disparities in earnings between education groups account for about one-third of the increase in overall wage inequality since the early 1980s (Bernhardt et al. 2001). Educational disparities in work conditions, employment benefits and job satisfaction have also increased (Fligstein and Shin 2004). Freeman (1999:4) warns that this "new inequality" is leading toward a "two-tiered society... in which the successful and upper-middle classes live fundamentally different from the working classes and poor." If Freeman is correct, then education is arguably the main dividing line by which these tiers are split.

In this article, I add to recent inequality research by examining whether disparities in health between education groups have also recently increased. Health, like wealth, is a main dimension of individual well-being, yet researchers know much less about trends in health disparities between education groups than about trends in earnings or income disparities. Evidence of increasing disparities in health would bolster claims of a growing social divide on the basis

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of education levels, whereas evidence of narrowing disparities would suggest that, in at least one important social domain, the importance of education for a person's life chances may be losing some force.

Background

Many studies show that education strongly predicts adult health and longevity. This relationship was first reported more than 30 years ago by Kitagawa and Hauser (1973) and has since been replicated by many other studies using improved data and numerous measures of health (e.g., Elo and Preston 1996; Mirowsky and Ross 2003; Rogers, Hummer and Nam 2000; Ross and Wu 1995, 1996; Schnittker 2004). In the United States, differences in health by education level range up to seven years or more in life expectancy and up to 12 years or more in the age at which disabling health problems first occur (Molla, Madans and Wagener 2004).

There are several reasons to expect that these differences have grown in recent years. First, as noted above, the 1980s and 1990s marked a period of rising social and economic inequality in the United States, especially between college-educated men and women and those without college degrees. In the mid-1970s, full-time male workers with bachelor's degrees earned about 50 percent more than comparable workers with high school degrees. By 1999, earnings among college-educated workers were about 80 percent greater (Cheeseman Day and Newburger 2002). Similar trends hold for a broad range of economic indicators, including work conditions, employment benefits and job satisfaction (Fligstein and Shin 2004). Because economic resources form one of the many pathways linking education and health (Ross and Wu 1995; Warren et al. 2004), increasing educational disparities in income and work conditions may translate into increasing disparities in health.

Second, recent evidence suggests that college graduates have also made gains in relation to important health-promoting behaviors such as cigarette smoking cessation (Harper and Lynch 2006). Smoking rates have plunged in the United States in the past 30 years, with the percentage of adults self-reporting as "current smokers" declining from nearly 37 percent in 1974 to roughly 22 percent in 2001 (NCHS 2003). But the rate of decline has varied widely by education level, with the largest declines occurring among college graduates. From 1974 to 2001, age-adjusted smoking rates declined from 44 percent to 31 percent among persons without high school degrees, from 36 percent to 28 percent among high school graduates, and from 27 percent to less than 11 percent among college graduates. In 1974, the chances of smoking were about 30 percent higher for high school graduates than for college graduates. By 2001, however, the chances of smoking were more than 150 percent higher for high school graduates. These trends predict greater health improvements among college graduates than among those without college degrees.

Third, recent studies also show evidence of large and perhaps growing educational disparities in access to and use of new health services and medical technology. For example, Lleras-Muney and Lichtenberg (2002) show that education is positively correlated with the use of new drugs recently approved by the Food and Drug Administration (FDA), and Goldman and Smith (2002) show in samples of diabetics and people infected with HIV that the best-educated patients are most likely to adhere to new complex treatment regimes and thus benefit from them. The net effect of recent medical innovation on educational disparities in health is still largely unknown, but the short-term effect is possibly inequality inducing (Glied and Lleras-Muney 2003).

Evidence

The few prior studies of time trends generally support these predictions, showing evidence of persistent or even increasing educational disparities in health, especially among older adults. Using disability data from the National Health Interview Survey (NHIS) and mortality data from both the National Longitudinal Mortality Study (NLMS) and Kitagawa and Hauser's (1973) matched-records study of the 1960 U.S. Census, Crimmins and Saito (2001:1637) found "large and growing" educational disparities in disability-free life expectancy from 1970 to 1990. Disability-free life expectancy improved in this period among people with 13 or more years of education but held relatively steady or declined among those with lower levels of education.

Similarly, Lynch (2003) found that the correlation between education and self-reported health status has strengthened among younger birth cohorts. His study sought to integrate cohort and life-course perspectives on the relationship between education and health by estimating the strength of the relationship at several ages for multiple birth cohorts. Drawing on repeated cross-sectional data from the 1972-1993 waves of the NHIS and longitudinal panel data from the National Health and Nutrition Examination Survey (NHANES), Lynch found that the strength of the relationship between education and self-reported health status varies with age but has strengthened at all ages among younger cohorts.

Most recently, Schoeni et al. (2005) used annual data from the NHIS to investigate trends in educational disparities in old-age disability from 1982 to 2002. Results of pooled cross-sectional analyses showed that college graduates achieved the largest relative declines in old-age disability in the 1980s and 1990s and that educational disparities in disability are thus larger today than they were two decades ago.

These findings mirror the results of a related body of research on trends in educational disparities in adult mortality rates. A highly publicized and widely cited study by Pappas et al. (1993) first suggested that educational disparities in adult mortality rates had widened in the United States in the second half of the 20th century (see also Feldman et al. 1989; Lauderdale 2001). Later, Preston and Elo (1995:476) updated and revised this finding by showing that the trend had also varied by gender, such that disparities in adult mortality had "widened for males but contracted for working-age females."

Coverage

Data constraints forced many of these studies to limit their analyses to comparisons of just two or three selected time points. For example, Pappas et al.

(1993) assessed trends by comparing mortality rates in 1986 with those Kitagawa and Hauser (1973) had earlier reported for 1960. Lynch (2003) achieved improved coverage by using annual data from the NHIS, but that study did not cover trends in the 1990s. The recent study by Schoeni et al. (2005) is one of the first to examine trends in the 1980s and 1990s, the period in which we know that other types of social and economic inequality increased.

Age Group Differences

Also unclear is the extent to which trends have varied by age group. Educational disparities in health are not constant across the life course but rather increase from early adulthood to early old age, then decline steadily thereafter (Herd 2006; House, Lantz and Herd 2005). Other studies report that educational disparities in health increase continuously throughout the life course (Ross and Wu 1996). To generate unbiased results, studies of time trends must account for this interaction (Lauderdale 2001; Lynch 2003).

If disparities have increased, this trend has most likely occurred among older adults, the only age group for which health problems are now common across all education levels. It is less likely that disparities have increased among younger adults, because poor health is less common in this age range, particularly among the best-educated Americans (House, Lantz and Herd 2005).

Consistent with this hypothesis, Preston and Elo (1995:491) found that the trend toward increasing educational disparities in adult mortality is "more adverse" for men and women ages 65 to 74 than for those younger than 65. But subsequent analyses by Crimmins and Saito (2001) and Lynch (2003) found that educational disparities in health have increased across all ages (see also Lauderdale 2001).

Compositional Change

It is also possible that widening educational disparities in health reflect change in the composition of the population rather than change in the relationship between education and health. One type of compositional change stems from changing mortality rates. Declining mortality rates and attendant gains in longevity have resulted in more people living longer. Other things being equal, this works to boost the population's average age and thus forces average population health downward. It is also possible that the added survivors are less healthy or more prone to illness than the population as a whole. The effects of changing mortality rates may also vary by education level, if mortality rates have declined most rapidly among the highest education groups.

A second type of compositional change stems from change in the distribution of educational attainment. From 1982 to 2002, the percentage of U.S. adults with at least a high school degree increased from 71 percent to 84 percent, and the percentage with at least a college degree increased from roughly 18 percent to nearly 27 percent (Newburger and Curry 2000). These gains have been accompanied by changing patterns of selection into education groups on the basis of such factors as race, gender, family social background or possibly preexisting health conditions, whereby higher-education groups have become relatively *less* selective and lower-education groups have become relatively *more* selective.

These changes will influence trends in educational disparities in health if the dimensions of compositional change also correlate with adult health outcomes. For example, if part of the association between education and health is explained not by a causal effect of education but rather by the long-term effects on both educational attainment and adult health status of family social background or preexisting health conditions, then any change in patterns of selection into education groups on the basis of these factors will also influence trends in educational disparities in health.

Research Strategy

In this article, I present new estimates of trends in educational disparities in health from 1982 to 2004 in an attempt to extend prior research by 1.) examining trends over a more recent period with annual data from a consistent data source, 2.) reexamining whether and how trends have varied by age group, and 3.) accounting for the possibility that trends reflect change in the composition of education groups rather than change in the relationship between education and health.

Data

My analysis is based on annual data from the National Health Interview Survey (NHIS), a repeated cross-sectional survey of the non-institutionalized U.S. population conducted annually by the National Center for Health Statistics (NCHS). In the analysis, I included data for all 23 surveys conducted from 1982 to 2004. The 1982 survey was the first to include the self-reported health measure featured in this study.[1] The 2004 survey is the most recent one for which data were publicly available.

Each yearly sample consists of the members of a nationally representative sample of U.S. households selected using a multistage cluster sampling design. Data were collected for all members of selected households, through self-reports for respondents ages 17 and older and through proxy response for children under 17 and for adults not present at the time of the interview. I excluded respondents under age 30, because their final education levels might not have been fixed at the time of the interview. The average sample size after excluding the younger respondents is roughly 55,000 people per year (unweighted). By sampling from only the non-institutionalized population, the NHIS excludes people living in nursing homes and other institutional settings.

To account for the complex sampling design, I used survey sampling weights throughout the analysis. The sampling weights include adjustments for nonresponse and the probability of selection, as well as a post-stratification adjustment for gender, age and race/ethnicity. I did not further adjust standard errors for the stratification and clustering employed in the sampling design, because the methods used to make these adjustments vary by year and because the variables and estimation methods NCHS has made available for this purpose were not designed for use in pooled cross-sectional research (NCHS 2005).

Sensitivity analyses conducted using data for single survey years (available upon request) indicated that ignoring the sample stratification and clustering does not greatly alter the results.

Measures

Health

I assessed health with a five-category measure of self-reported health status. To make the results of the analysis easier to interpret, I recoded the measure into a dichotomous variable coded 1 for people reporting "fair" or "poor" health and 0 for people reporting "good," "very good" or "excellent" health. To check the robustness of the results to alternative coding schemes, I performed additional analyses using, first, the complete five-category variable and, second, an alternative dichotomous variable coded 1 for people reporting "good," "fair" or "poor" health and 0 for those reporting "very good" or "excellent" health. Results were similar.

Prior studies have shown measures of self-reported health to have high test-retest reliability (Lundberg and Manderbacka 1996) and to strongly predict mortality risk and other health outcomes (Benjamins et al. 2004; Idler and Benyamini 1997). Self-reported health status is also the only measure of general health status in the NHIS that has remained largely unchanged across periodic revisions of the survey instrument. For example, the survey's primary measure of limitation in physical functioning was changed significantly in 1997, so responses to this measure are not directly comparable over time.

Education

Education is measured with a self-report of the highest level of formal schooling completed. The measure is collapsed into an ordinal variable with categories for college graduates (16 or more years of formal schooling completed), high school graduates (12 to 15 years of formal schooling completed), and people without high school degrees (less than 12 years of formal schooling completed). I used these categories in part because they coincide with the assignment of major educational credentials and in part because they mark the points on the education distribution at which disparities in self-reported health by education level are largest.[2]

The change in the composition of education groups is addressed in two ways. First, compositional change is accounted for directly by including control variables for several basic demographic characteristics, including age, gender, race, Hispanic ethnicity, marital status and geographic region. The main limitation of this approach is that there may be additional sources of compositional change that could not be measured, such as changing patterns of selection into education groups on the basis of family social background or preexisting health conditions.

Second, I reran the regression part of the analysis using a relative measure of educational attainment that divides each yearly sample into three groups of equal size, corresponding to the bottom, middle and top thirds of the education distribution. The use of these education terciles addresses compositional change because the composition of relative education groups has arguably changed less than has the composition of fixed education groups. For example, the proportionate size of the relative groups is unchanging by construction, whereas the fixed groups have become proportionately larger (college graduates) or smaller (people without high school degrees) over time. Similarly, any change in patterns of selection into education groups on the basis of family social background or preexisting health problems is probably less pronounced in the context of relative education groups.[3]

Dividing the sample into education terciles is complicated by the clustering of respondents on selected education levels, especially 12 years and 16 years. For example, more than 30 percent of the pooled sample reports having completed 12 years of formal schooling. This clustering creates cases in which many respondents fall on the cutoff point between two terciles. In these instances, I assigned the clustered respondents randomly and in the proportions needed to create groups of equal size.

Control Variables

A limited number of demographic control variables is included for gender (coded 1 for women and 0 for men); race (coded white, black, and other); Hispanic ethnicity (coded 1 for Hispanics and 0 for non-Hispanics); marital status (coded married, separated or divorced, widowed, and never married); age (coded in years); and geographic region (coded Northeast, Midwest, South, and West). For reasons discussed in the results section below, I also included a dummy variable for surveys conducted after 1996 (coded 1 for surveys conducted after 1996, and 0 otherwise). Measures of income or wealth were not included because they tap into possible explanations of the changing relationship between education and health, whereas the main goal of the present analysis is rather to first map out the overall trends. Appendix A displays percentage distributions for all the variables included in the analysis for 5 of the 23 survey years.

Analysis

To determine whether disparities have increased, I pooled the data for all 23 surveys and estimated a series of binary logistic regression models of the following general form:

$$logit(p_{it}) = \alpha + \beta_1 e_{1it} + \beta_2 e_{2it} + \beta_3 y_{it} + \beta_4 [e_{1it} \times y_{it}] + \beta_5 [e_{2it} \times y_{it}], \quad (1)$$

where p_{it} is the predicted probability of reporting fair or poor health for the *i*th respondent in survey year *t*; e_1 and e_2 are dummy variables for people without high school degrees and high school graduates, respectively (so college graduates are the reference group); and y is a linear index of survey year coded from 0 for the 1982 survey to 22 for the 2004 survey. The terms β_1 and β_2 denote the difference in the predicted log-odds of reporting fair or poor health between college graduates (the reference group) and either high school graduates (β_2) or people without high school degrees (β_1). Because the model also includes interactions between the education variables and the index of survey year, the terms β_1 and β_2 are conditional on $y = 0$. This value of y corresponds with the baseline survey year, 1982, so β_1 and β_2 denote baseline disparities in health. The terms β_4 and β_5 then show how the initial baseline differences changed over the subsequent 22 years. A positive coefficient denotes an increasing difference, a negative coefficient a narrowing difference. The term β_3 denotes the average annual change in the predicted log-odds of reporting fair or poor health for college graduates, the reference group. A negative coefficient indicates health improvement, a positive coefficient health decline.

To determine whether trends vary by age, I performed the analysis separately for three age groups: 30-49, 50-69, and 70 and older. I stratified the analysis by age group because a pooled analysis of all age groups combined requires estimating a model with a higher-order three-way interaction among education, survey year and age, and this model does not easily capture differences in trends between age groups (see Appendix B). I found similar results when using 10- or 15-year age groups rather than 20-year groups.[4]

The logistic regression models test for change in *relative* health disparities as measured by odds ratios or differences in log-odds. Many studies in the health literature, however, suggest that testing instead for change in *absolute* percentage-point disparities can lead to different results (Keppel et al. 2005). To address this concern, I reran the regression part of the analysis using linear probability models instead of binary logistic models. To make the results of the linear probability models easier to interpret, I recoded the self-reported health measure 0,100 instead of 0,1. To account for the problem that linear probability models violate the ordinary least squares (OLS) assumption of constant variance in the error term across values of the independent variables, I report significance tests calculated with robust standard errors (Wooldridge 2000).[5]

Finally, this type of pooled cross-sectional analysis always confronts the problem of disentangling age, period, and cohort effects. I identified the age effect by stratifying the analysis by age group and by including an additional control for age in the adjusted regression models. The resulting trends thus reflect a mix of cohort and period effects.

Results

Table 1 reports basic descriptive trends. Consistent with the findings of much prior research, there are large disparities in self-reported health between education groups, with college graduates reporting better health on average than high school graduates, and high school graduates reporting better health on average than people without high school degrees. The largest differences appear in the middle age group, with the probability of reporting fair or poor health up to 9 percentage points lower for college graduates than for high school graduates and up to 30 percentage points lower for college graduates than for people without high school degrees.

Results for the oldest age group support claims that college graduates have achieved the largest recent gains in health among the elderly (see also Schoeni et al. 2005). From 1983 to 2003, the probability of reporting fair or poor health declined by nearly 7 percentage points among college graduates, declined by roughly 3 percentage points among high school graduates, and held relatively steady among people without high school degrees.

Table 1: Percent Reporting Fair or Poor Health

		Education Level			
Age Group	Year	< 12 Years	12-15 Years	16+ Years	All Education Levels
70+	1983	40.3	26.4	22.7	34.1
	1988	39.3	23.8	18.2	30.9
	1993	38.0	24.8	19.1	29.6
	1998	40.0	23.0	13.7	28.0
	2003	39.5	23.4	16.1	27.0
50-69	1983	39.3	17.5	8.3	24.2
	1988	35.6	16.0	8.3	20.8
	1993	38.5	16.5	8.6	20.5
	1998	36.2	14.9	6.3	17.2
	2003	37.3	16.7	7.0	17.4
30-49	1983	22.4	7.2	2.4	8.9
	1988	20.1	6.8	2.6	7.6
	1993	21.5	8.5	3.1	8.7
	1998	17.9	7.4	2.5	7.3
	2003	17.9	8.4	3.0	8.0

Source: National Health Interview Survey (NHIS), respondents ages 30 and older.

In contrast, results for the two younger age groups show less variation in trends by education level. For the middle age group, all three education groups registered a slight improvement in self-reported health, with the probability of reporting fair or poor health declining by roughly 2 percentage points among people without high school degrees and by 1 percentage point among both high school graduates and college graduates. For the youngest age group, only the lowest-education group showed any improvement in self-reported health, as the probability of reporting fair or poor health among both high school graduates and college graduates remained largely unchanged. Taken together, these findings suggest that educational disparities in self-reported health status increased among older adults but not among younger ones.

It is possible that the low percentages reported in Table 1 for the youngest age group reflect censoring by my health measure and that a more objective measure would show greater variation in health among younger adults. However, this argument does not square with evidence that more objective health measures such as mortality and morbidity rates also show little variation in health among this age group (e.g., Molla et al. 2004). Moreover, in additional descriptive analyses (not reported, but available upon request), I found that at least part of the 5-percentage-point drop in the probability of reporting fair or poor health among 30- to 49-year-olds in the lowest-education group might reflect a change in the survey instrument rather than a true improvement in self-reported health. Most of the decline occurred between 1996 and 1997, and this timing coincides with a switch to a redesigned survey instrument in 1997. The survey redesign did not involve any changes to the self-reported health measure, but other changes to the survey instrument (such as the addition of new questions on limitation in physical functioning before the self-rated health item or the reordering of items in the questionnaire) might have influenced response patterns. I accounted for the survey change in the regression models by including a dummy variable for surveys conducted after 1996.

Because the NHIS samples from only the non-institutionalized population, it is hard to assess the impact of this exclusion on the figures in Table 1. However, it probably results in a conservative estimate of the extent of health improvement among older adults, because the percentage of older adults living in nursing homes has declined in the past 20-25 years (Bishop 1999; Manton and Gu 2001), so the NHIS now samples from a broader and possibly less healthy cross-section of the older population. It is also likely that the bias most severely affects the estimates for my highest-education group, because the decline in the relative size of the nursing home population has occurred most rapidly among the most advantaged segments of the population (Ness, Ahmed and Aronow 2004). The estimates in table 1 thus probably understate the degree to which recent gains in health among older adults have been concentrated among college graduates. Even so, the size of any bias is likely small, because the institutionalized population

Table 2: Logistic Regression Results

		Unadjusted		Adjusted	
Age Group	Independent Variable	B	SE	b	SE
70+	Education: < 12	.870***	(.042)	.824***	(.043)
	Education: 12-15	.237***	(.044)	.286***	(.044)
	Year	-.020***	(.003)	-.023***	(.003)
	Year × < 12	.018***	(.003)	.016***	(.003)
	Year × 12-15	.014***	(.003)	.012***	(.003)
50-69	Education: < 12	1.837***	(.032)	1.709***	(.032)
	Education: 12-15	.722***	(.032)	.725***	(.032)
	Year	-.017***	(.002)	-.018***	(.002)
	Year × < 12	.013***	(.002)	.010***	(.003)
	Year × 12-15	.013***	(.002)	.011***	(.002)
30-49	Education: < 12	2.402***	(.036)	2.224***	(.037)
	Education: 12-15	1.055***	(.035)	1.022***	(.036)
	Year	.015***	(.003)	.008**	(.003)
	Year × < 12	-.019***	(.003)	-.015***	(.003)
	Year × 12-15	.001	(.003)	-.001	(.003)

Notes: Numbers in parentheses are robust standard errors. Models were estimated separately by age group. See text for details.

*p < .05 **p < .01 ***p < .001 (two-tailed tests) accounts for only 4 to 5 percent of the total adult population ages 65 and older (Manton and Gu 2001) and because recent studies of trends in old-age disability indicate that both the community-dwelling and institutionalized populations have recently experienced similar trends in health (Freedman et al. 2004).

Table 2 reports the logistic regression results. Included in this table are coefficients from binary logistic regression models estimated separately by age group with the full sample of pooled data for all 23 survey years. Coefficients are reported for education and survey year, but not for the control variables added to the adjusted models.[6]

The regression results generally support the main findings of the basic descriptive results. The significant coefficients for the education dummy variables confirm that both high school graduates and people without high school degrees report significantly worse health on average than do college graduates. The coefficients are in the expected positive direction, indicating worse self-reported health among lower education groups. Recall that these coefficients reflect baseline differences in 1982.

The key new findings involve the coefficients for the interaction terms. Three findings stand out. First, I find strong evidence of increasing disparities in self-reported health among adults ages 70 and older. The adjusted regression results imply that the odds of reporting fair or poor health were about 2.3 times greater for the lowest education group than for the highest education group in 1982 (i.e., exp[.824] = 2.3). By 2004, the odds for the lowest education group were about 3.2 times greater (i.e., exp[.824 + (.016 x 22)] = 3.2), an increase of roughly 39 percent.

Disparities increased among older adults because self-reported health improved more among college graduates than among those without college degrees. The coefficient for the main effect for survey year indicates that the log-odds of reporting fair or poor health declined among college graduates at an average annual rate of .023 points per year (adjusted model). Determining the rate of health improvement for the two lower-education groups requires adding the coefficients for the interaction terms to the coefficient for survey year. The results of the adjusted model indicate that the log-odds of reporting fair or poor health declined at an average annual rate of .011 points per year among high school graduates (i.e., -.023 + .012 = -.011) and .007 points per year among people without high school degrees (i.e., -.023 + .016 = -.007).

Second, I find more limited evidence of increasing disparities for the middle age group. The coefficients for the interaction terms for this age group appear similar in size to the coefficients for the oldest age group, but they imply somewhat smaller substantive effects. For example, the adjusted regression results for adults ages 50-69 imply that the odds ratio for the relative health difference between the lowest- and highest-education groups increased from a low of 5.5 in 1982 to a high of 6.9 in 2004, an increase of roughly 25 percent. Although this difference is statistically significant, it is relatively smaller than the change observed among older adults.

Third, I find no evidence of increasing disparities for the youngest age group. The negative coefficient for one of the two interaction terms suggests that disparities narrowed between the highest- and lowest-education groups. The non-significant coefficient for the other interaction term suggests that disparities between the highest- and middle-education groups remained largely unchanged.

To get a better sense of the size of the trends, Figure 1 plots the predicted probability of reporting fair or poor health by education and age group for two selected survey years. These figures are calculated from the age-specific adjusted logistic regression models in Table 2. The figure shows evidence of widening disparities among the oldest age group but smaller changes among the two younger groups.

Figure 1 also illustrates why educational disparities in health have tracked in different directions for different age groups. For the youngest age group, few high school graduates or college graduates report having fair or poor health, so the lowest-education group has determined the direction of the overall trend. Because health improved among people without high school degrees, educational disparities in health declined. But for the oldest age group, all three education groups have room for further health improvement, so all three have contributed to the direction of the trend. Because self-reported health improved more among college graduates than among those without college degrees, educational disparities in health increased.

One other important finding in Table 2 concerns the close match between the unadjusted and adjusted regression results. Adding demographic control variables to the models has little effect on the size of the coefficients, and statistical significance levels remain largely unchanged. This similarity indicates that the trends do not totally or primarily reflect change in the basic demographic composition of education groups and that any remaining compositional effects must involve factors beyond those captured by age, gender, race, Hispanic ethnicity, marital status and geographic region.

Table 3 reports the results of the linear probability models, which examine trends in absolute percentage-point disparities. Many studies in the health literature suggest that the difference between relative and absolute disparities is important (Keppel et al. 2005). In this case, however, the results are generally similar. The biggest difference concerns the middle-aged group, where coefficients for the interaction terms are generally positive in the logistic regression and the linear probability models, but only in the logistic models do they reach statistical significance (adjusted models).

What accounts for the difference? The basic descriptive results showed relatively little difference in recent trends in self-reported health by education level for the middle age group. The probability of reporting fair or poor health declined from 1983 to 2003 by 1.3 percentage points among college graduates, 0.8 percentage points among high school graduates, and 2.0 percentage points among people without high school degrees (Table 1). However, because each group started from a different baseline value, these absolute percentage-point declines imply that college graduates achieved the largest relative decline of 15.7 percent (i.e., [8.3 – 7.0]/8.3 = .157), compared with smaller relative declines of 4.5 percent for high school graduates and 5.1 percent for people without high school degrees. A larger relative decline among college graduates means that

Figure 1. Predicted Probabilities of Reporting Fair or Poor Health by Education Level, Age Group and Survey Year

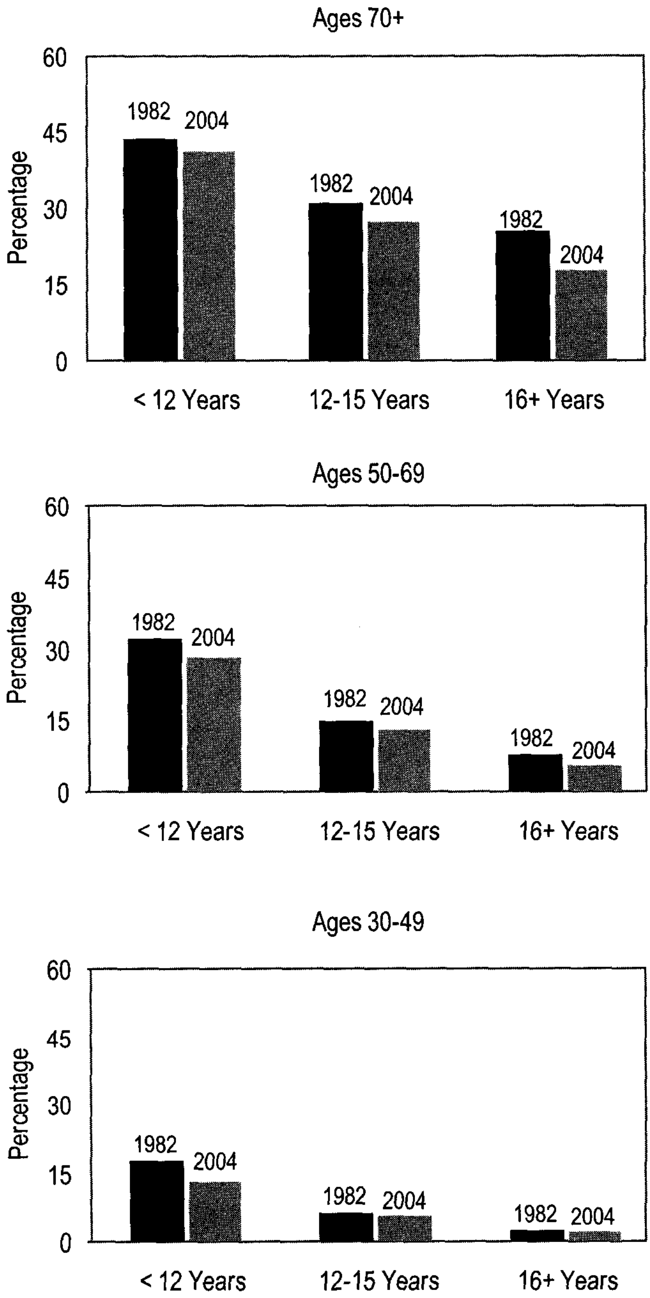

Table 3: Linear Probability Models

Age Group	Independent Variable	Unadjusted B	Unadjusted SE	Adjusted b	Adjusted SE
70+	Education: < 12	18.011***	(.713)	16.809***	(.710)
	Education: 12-15	4.328***	(.718)	5.259***	(.715)
	Year	-.320***	(.052)	-.366***	(.051)
	Year × < 12	.268***	(.053)	.229***	(.053)
	Year × 12-15	.192***	(.052)	.163**	(.051)
50-69	Education: < 12	29.161***	(.354)	26.649***	(.354)
	Education: 12-15	7.897***	(.277)	7.786***	(.278)
	Year	-.120***	(.022)	-.140***	(.021)
	Year × < 12	.045	(.029)	-.015	(.029)
	Year × 12-15	.073***	(.020)	.029	(.020)
30-49	Education: < 12	19.663***	(.274)	18.035***	(.271)
	Education: 12-15	4.438***	(.120)	4.108***	(.120)
	Year	.076***	(.010)	.023*	(.010)
	Year × < 12	-.214***	(.022)	-.175***	(.022)
	Year × 12-15	.037***	(.010)	.022*	(.010)

Notes: Numbers in parentheses are robust standard errors. Models were estimated separately by age group. See text for details.
*p < .05 **p < .01 ***p < .001 (two-tailed tests)

relative disparities in self-reported health status increased in this period, even though absolute percentage-point disparities remained largely unchanged. The positive coefficients for the interaction terms in the logistic regression models reflect the trend of increasing relative disparities in health, and the non-significant coefficients in the linear probably models reflect the trend of relatively stable absolute percentage-point disparities.

There is also a minor difference between the logistic and linear probability models in the results for the youngest age group. For this age group, the coefficients for the interaction terms for high school graduates are positive and significant in the linear probability models but not in the logistic models. However, the size of the significant effect in the linear probability models is modest. Predicted probabilities from the adjusted model in Table 3 indicate that the difference in the probability of reporting fair or poor health between high school graduates and college graduates edged up from roughly 4.1 percentage points in 1982 to 4.6 percentage points in 2004 (i.e., 4.1 + [.022 × 22] = 4.6). Overall, the results show more evidence of declining than increasing disparities among younger adults.

Table 4 displays results of the additional logistic regression models estimated using relative instead of fixed education groups. These models assess the

Table 4: Regressions with Education Terciles

Age Group	Independent Variable	Unadjusted B	Unadjusted SE	Adjusted b	Adjusted SE
70+	Education: Bottom 3rd	.845***	(.027)	.726***	(.027)
	Education: Middle 3rd	.383***	(.028)	.375***	(.028)
	Year	-.019***	(.002)	-.023***	(.002)
	Year × Bottom 3rd	.009***	(.002)	.011***	(.002)
	Year × Middle 3rd	-.001	(.002)	.001	(.002)
50-69	Education: Bottom 3rd	1.466***	(.021)	1.323***	(.021)
	Education: Middle 3rd	.413***	(.022)	.430***	(.023)
	Year	-.025***	(.002)	-.027***	(.002)
	Year × Bottom 3rd	-.001	(.002)	-.001	(.002)
	Year × Middle 3rd	.016***	(.002)	.012***	(.002)
30-49	Education: Bottom 3rd	1.668***	(.028)	1.546***	(.029)
	Education: Middle 3rd	.862***	(.030)	.831***	(.031)
	Year	.012***	(.002)	.004	(.002)
	Year × Bottom 3rd	-.016***	(.002)	-.015***	(.002)
	Year × Middle 3rd	-.003	(.002)	-.005*	(.002)

Notes: Numbers in parentheses are robust standard errors. Models were estimated separately by age group. See text for details.
*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

possibility of additional compositional effects beyond those captured by the basic demographic control variables. Possible examples of such effects include changing patterns of selection into education groups on the basis of family social background or preexisting health problems. The top tercile is omitted as the reference group, so the estimates report differences in self-reported health between the top third of the education distribution and each of the two lower thirds.

The use of a relative education measure somewhat attenuates the strength of the interaction terms in the models for the oldest and middle age groups, suggesting a possible effect of compositional change that cannot be measured in these data. But in the models for the oldest age group, the interaction term for the bottom education tercile remains positive and statistically significant, and in the models for the middle age group, the interaction term for the middle education tercile remains positive and statistically significant. The estimates for the youngest age group are similar regardless of the method used to measure education. In short, even the use of relative education groups does not greatly alter the main substantive results.

Overall, most of the evidence points to the same conclusion: increasing educational disparities in self-reported health for adults ages 70 and older, relatively stable disparities for adults ages 50-69, and narrowing disparities for adults ages

30-49. There is also limited evidence of increasing disparities among the middle age group, but this evidence is sensitive to the measurement of absolute versus relative disparities and the size of any change is relatively modest.

Discussion and Conclusion

Research on inequality in America shows evidence of a growing social and economic divide between college-educated men and women and people without college degrees. This "new inequality," predicted 30 years ago by Bell (1973) and other social theorists, is now widely regarded as one of the defining features of American society in the early 21st century. Prior research in this area has focused mostly on trends in economic inequality, so in this study I instead looked at trends in educational disparities in health.

Analyses of repeated cross-sectional data from the National Health Interview Survey (NHIS) corroborate the well-known finding that education is strongly predictive of adult health, including the measure of self-reported health status featured in this study. College graduates report better health on average than do high school graduates, and high school graduates report better health on average than do people without high school degrees.

New findings show that educational disparities in self-reported health increased from 1982 to 2004 among older adults (ages 70 and older) but held relatively steady (ages 50-69) or narrowed (ages 30-49) among younger adults. The finding of increasing disparities among older adults is not an artifact of the health measure employed, as other recent studies report similar results for alternative measures of health. The finding of relatively stable or narrowing disparities among younger adults is new, but it should not be surprising given the overall good health status of this segment of the population. There is little room for further health improvement among younger adults with at least a high school degree, so a modest improvement in self-reported health among lower-education groups has led educational disparities in health to decline.

Additional analyses show that these trends do not totally or primarily reflect change in the demographic composition of education groups. Average education levels in the United States continue to increase as older, less-educated cohorts are replaced in the population by younger, more-educated cohorts. Because of this, the demographic composition of education groups has changed, with higher-education groups becoming relatively larger and perhaps relatively more diverse and lower-education groups becoming relatively smaller and perhaps relatively less diverse. Moreover, as adult mortality rates continue to decline, life expectancy increases, and this adds another source of change in population composition. However, my regression results show that the two main trends of increasing disparities for older adults and relatively stable or declining disparities for younger adults hold up after adjusting for such demographic characteristics as age, race, ethnicity, gender, marital status and geographic region. A second test – the use of relative rather than fixed education groups – shows somewhat stronger effects of compositional change, but the main findings still persist.

These findings are generally consistent with the predictions of prior theory and research, except for possible differences in trends by age group. Lynch (2003) found that educational disparities in self-reported health status have increased at all ages. I find instead that the trend of increasing disparities has occurred primarily among older adults. What accounts for the difference? One possibility is coverage. Lynch focused primarily on trends in the 1970s and 1980s, whereas I focus on more recent trends from 1982 to 2004. Another possibility is modeling. Because Lynch sought to estimate cohort and life-course trends simultaneously, he based his results on a pooled cross-sectional regression model that included data for all age groups combined. However, these models do not easily capture possible differences in trends between age groups (see Appendix B). To focus more on the question of possible age group differences, my analysis is stratified by age.

The differences in trends between age groups may partly reflect both ongoing changes in the demography of aging and recent improvements in overall population health. In the United States and other rich countries, infant and child morbidity rates are now relatively low, so recent improvements in overall population health have turned mostly on health improvements in adulthood and on the ability of recent adult cohorts to delay the onset of health problems to increasingly older ages (Cutler and Meara 2004). Health researchers sometimes refer to this process as the "compression of morbidity" (Fries 1980), to the extent that it reflects the concentration or "compression" of health problems to a relatively short period at the end of life. The results of this analysis indicate that college graduates have a large and growing lead in this process, which explains the trend of increasing disparities recorded among older adults (see also House, Lantz and Herd 2005). Lower-education groups have also achieved some modest success in postponing the onset of health decline, however, which explains the trend of narrowing disparities found among younger adults.

Less certain is the extent to which the relative success of college graduates in achieving health improvements at older ages owes to broader social processes involving large and growing educational disparities in 1.) economic resources, including income and family wealth; 2.) health-promoting behaviors like cigarette smoking cessation, increased physical activity, and improved diet and body mass; and 3.) access to and use of new health services and medical technology. The challenge for future research is to further examine these broader social processes and to determine which of these factors might account for the recent trend of increasing educational disparities in health found among older adults.

Finally, as more and better time-series data become available, future studies should also seek to replicate these findings with alternative measures of health. Given the strong correlation between self-reported health and most other common measures of general health status, confirmatory analyses should yield similar results. However, researchers still do not fully understand the varied and complex factors people consider in evaluating their own health, and responses to self-reported health measures likely vary systematically by factors like gender, race, nativity, socioeconomic status, age, prior health history and personal disposition, independent of a person's underlying health status. Response patterns might also vary with changes in broader social, economic and political conditions, independent of changes in overall population health. In the end, understanding the causes of the trends reported in this study will require more detailed knowledge of the specific disabilities, conditions, diseases and social environments that all contribute to aggregate trends in self-reported health.

Notes

1. Earlier surveys included a similar measure but with a different number of response categories. Before 1982, there were four response categories; since 1982, there have been five.

2. I do not mean to imply that the effects of education on health work more through formal educational credentials than through years of formal schooling completed. Indeed, prior research suggests that educational credentials have little added effect on health after adjusting for years of formal schooling (Ross and Mirowsky 1999). Moreover, although I refer to respondents in my highest-education group as "college graduates," readers should not take this term too literally, because some respondents with at least 16 years of education might not have a college degree.

3. There may also be theoretical reasons for preferring a relative measure of education. For example, if the effects of education on health work primarily through occupation and income or through access to medical services and technology, then it may be more important to measure relative position within the education distribution than number of years of schooling completed or type of educational credential.

4. In additional sensitivity analyses, I also estimated regression models separately by gender. Educational disparities in health are generally smaller for women than for men, but the trends are similar by gender. Sample sizes are too small for the oldest age group to estimate models separately by race or ethnicity.

5. To check the sensitivity of the results to alternative models, I also estimated comparable ordered logit, ordered probit and OLS models using the full five-category, self-reported health measure. Results were similar.

6. The coefficients for the control variables matched prior expectations, with the likelihood of reporting fair or poor health lower for men than for women; lower for whites and other racial groups than for blacks; lower for non-Hispanics than for Hispanics; lower for married people than for people who are divorced, separated or never married; and lower for people living in the Northeast, Midwest and West than for people living in the South. The likelihood of reporting fair or poor health also increases with age and declines in surveys conducted after 1996. The finding of worse self-reported health among Hispanics runs somewhat counter to the "Hispanic Paradox" finding of lower mortality rates and better health behaviors among this ethnic group (Elo et al. 2004; Palloni and Arias 2004), but it matches the results of other recent analyses of NHIS data (NCHS 2003, Table 57).

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Appendix A. Descriptive Statistics

Variable	Year 1983	1988	1993	1998	2003
Self-Reported Health					
Good, very good, or excellent[a]	82.0	84.7	84.6	86.6	86.0
Fair or poor	18.0	15.3	15.4	13.4	14.0
Education					
< 12 years	30.4	24.5	20.8	18.4	16.2
12–15 years	52.0	55.3	57.0	57.1	57.3
16+ years[a]	17.6	20.2	22.2	24.5	26.5
Age					
30–49	50.2	53.1	54.8	54.5	51.6
50–69	35.7	32.5	30.5	31.0	33.8
70+	14.1	14.4	14.7	14.5	14.6
Gender					
Male[a]	46.5	46.9	47.3	47.5	47.5
Female	53.5	53.1	52.7	52.5	52.5
Race					
White[a]	88.2	86.9	85.7	84.2	84.8
Black	9.6	10.1	10.6	10.4	10.8
Other	2.2	3.0	3.7	5.4	4.4
Hispanic Ethnicity					
Non-Hispanic[a]	94.6	94.1	93.4	91.3	89.4
Hispanic	5.4	5.9	6.6	8.7	10.6
Marital Status					
Married[a]	73.6	72.5	71.5	68.4	67.4
Divorced	10.5	9.7	9.1	8.6	8.3
Never married	9.8	10.5	11.2	13.4	14.0
Widowed	6.1	7.3	8.2	9.6	10.3
Geographic Region					
Northeast	22.5	21.5	20.4	19.9	19.5
Midwest	25.5	24.5	24.4	24.6	23.7
South[a]	32.6	33.6	33.4	35.9	37.3
West	19.4	20.4	21.8	19.6	19.5

[a] Denotes reference category in regression models.

Appendix B. Estimating Age Group Differences

In this appendix, I explain why I stratified the analysis by age group rather than pooling the data and estimating a single model for all age groups combined. A pooled analysis that accounts for age group differences requires estimating a model with a higher-order three-way interaction between education, survey year, and age:

$$logit(p_{it}) = \alpha + \beta_1 e_{it} + \beta_2 y_{it} + \beta_3 a_{it} + \beta_4 [e_{it} \times y_{it}] + \beta_5 [e_{it} \times a_{it}] + \beta_6 [y_{it} \times a_{it}] + \beta_7 [e_{it} \times y_{it} \times a_{it}], \quad \text{(B1)}$$

where p_{it} is the predicted probability of reporting fair or poor health for the *i*th respondent in survey year *t*; *e* is a dichotomous indicator of educational attainment coded 0 for college graduates and 1 for people without college degrees; *a* is a continuous measure of age; and *y* is a linear index of survey year coded from 0 for the 1982 survey to 22 for the 2004 survey. For convenience, I used a binary measure of educational attainment, but a three- (or more) category variable works equally well. This model is similar to one of the models featured in Lynch's (2003, p. 319) study.

The key term in the model is β_4, which shows how the effect of education (*e*) on self-reported health changes with time (*y*). Lynch (2003) based his conclusion of increasing educational disparities in health on the direction of this coefficient. A potential problem with this conclusion, however, is that β_4 is conditional on $a = 0$, so with age included in the model as an uncentered variable, the term β_4 assesses change in the effect of education on health for newborns. Centering age on a different number like 30, 50, or 70 makes the result more meaningful, but in limited way. For example, centering age on 30 makes the coefficient reflect change in the effect of education on health for 30-year-olds, centering age on 50 makes the coefficient reflect change for 50-year-olds, and so on.

However, because trends in educational disparities in health have varied by age group (see tables 2 and 3), one can manipulate the coefficient β_4 by centering the age variable on different values. For example, because disparities have increased among adults ages 70 and older, centering the age variable on 70 or 75 yields a positive and statistically significant coefficient. But centering instead on age 30 or 40 yields a negative coefficient because disparities have remained constant or narrowed among younger adults. To illustrate, appendix table B1 reports estimates of three pooled logistic regression models identical in all respects except the centering of the age variable. The coefficient for the interaction between education and year changes from negative and significant in models with age centered on 30 to positive and significant in models with age centered on 70. To avoid this problem, I adopted the alternative strategy of stratifying my analysis by age group.

Table B1: Pooled Logistic Regression Results

Independent Variable:	Age Variable Centered On: 30	50	70
Education	1.6988***	1.3105***	.9223***
	(.0421)	(.0223)	(.0289)
Year	.0070*	-.0067***	-.0205***
	(.0033)	(.0017)	(.0022)
Age	.0629***	.0629***	.0629***
	(.0014)	(.0014)	(.0014)
Education × Year	-.0111**	-.0032	.0047*
	(.0034)	(.0018)	(.0023)
Education × Age	-.0194***	-.0194***	-.0194***
	(.0014)	(.0014)	(.0014)
Year × Age	-.0007***	-.0007***	-.0007***
	(.0001)	(.0001)	(.0001)
Education × Year × Age	.0004**	.0004**	.0004**
	(.0001)	(.0001)	(.0001)
Constant	-4.1749***	-2.9176***	-1.6602***
	(.0405)	(.0214)	(.0279)

Note: Numbers in parentheses are robust standard errors. See equation B1 for description of the model.

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