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3

Socioeconomic and Demographic Disparities in Trends in Old-Age Disability

Robert F. Schoeni, Vicki A. Freedman, and Linda G. Martin

3.1 Introduction

Socioeconomic and demographic disparities in health status are substantial. Disparities are greatest in midlife, but gaps in old age remain large (House et al. 1990; House et al. 1994). Among people ages sixty-five and older, minority and socioeconomically disadvantaged populations are much more likely than other groups to experience disability and the physical, cognitive, and sensory limitations that underlie it (Freedman and Martin 1999; Freedman, Aykan, and Martin 2001; Manton and Gu 2001). Disability prevalence increases rapidly with age, and women, including widows, have much higher prevalence rates. The burden of disability clearly falls disproportionately on less-advantaged groups.

In the 1980s, research revealed that population health and disability were worsening (Colvez and Blanchet 1981; Verbrugge 1984). Subsequent research questioned that conclusion (Waidmann, Bound, and Schoenbaum 1995), and studies of the elderly, in particular, began to find significant reductions in disability (Manton, Corder, and Stallard 1993). Based on a stream of research on the topic starting in the late 1990s, the current

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evidence suggests that old-age disability has declined by roughly 1.5 percent per year during the past two decades (Freedman, Martin, and Schoeni 2002). Declines of this magnitude have wide-ranging implications for individuals and society, including the potential for substantial savings in health and long-term care spending (Waidmann and Liu 2000).

Disparities in health and disability have historically been large, and disability has declined recently, but only a handful of studies have explored whether disparities in disability have widened or narrowed (for a review see Freedman, Martin, and Schoeni 2002). Moreover, exploring whether the gains have been experienced widely or only among certain socioeconomic and demographic groups may provide insights into determinants of the decline.

The goal of this study is to document changes in disparities in old-age disability across the most salient socioeconomic and demographic groups, including education, income, and race/ethnicity, as well as age, sex, marital status, and region of residence. The chapter begins with a description of the data and methods, followed by a statement of the results and a discussion of the implications of the findings.

3.2 Data and Methods

The analysis is based on the National Health Interview Survey (NHIS), which is a repeated cross-sectional survey of the noninstitutionalized population in the United States. Conducted annually by the National Center for Health Statistics, the NHIS includes in each year a sample of roughly 8,000 adults age seventy and older. The analysis uses data from each year 1982 to 2002, resulting in a sample of 172,227 men and women ages seventy and older during this period.[1] These large samples allow relatively precise estimates of disability prevalence among elderly persons for each year, including estimates for some major subgroups. The sampling plan follows a multistage area probability design that permits the representative sampling of households. The *final basic weights*, which have been post-stratified to represent the civilian noninstitutional population, are used in all estimation. The statistical software program SUDAAN is used to adjust statistical tests for the complex nature of the survey design.

Disability is measured in different ways across the major national surveys, and empirical evidence finds that some measures have changed at varying rates (Freedman et al. 2004). The defining dimension of disability in the two questions in the NHIS is need for personal help. The first question asks about help with activities of daily living (ADL): "Because of any impairment or health problem, does _____ need help of other persons with

1. People age seventy in 1982 are not included because they were not asked the same disability questions.

personal care needs, such as eating, bathing, dressing, or getting around this home?" Those who answered no to this question were then asked about limitations with instrumental activities of daily living (IADL): "Because of any impairment or health problem, does _____ need help of other persons in handling routine needs, such as everyday household chores, doing necessary business, shopping, or getting around for other purposes?" Prior to 1982 the questions were substantially different. The questions were slightly modified in 1997, with the introductory phrase using the following alternative language: "Because of a physical, mental, or emotional problem, does . . ." Estimates of disability prevalence are reported for any disability (i.e., either ADL or IADL disability).[2]

Disparities are examined by education, income, race/ethnicity, age, sex, marital status, and region. Education is classified into five groups: zero to eight, nine to eleven, twelve, thirteen to fifteen, and sixteen or more years. Disability prevalence is also reported for year-specific quartiles in the total family income distribution. Unlike education, then, the proportion of the population in each income group remains the same across each year. In survey years 1982–1996 (1997–2002), family income is reported by the respondent as being in one of twenty-six (eleven) categories. In order to stratify prevalence estimates by income quartiles, we calculated a continuous income amount within categories, using a three-step procedure. First, for each year 1982 to 2002, we used the seventy-and-older population from the March Current Population Survey (CPS)—which is the U.S. Census Bureau's source for official estimates of income and poverty—to estimate family income as a function of sociodemographic variables and the family income categories appearing in the NHIS. For respondents missing income information altogether, we estimated a separate prediction equation without the income bracket indicators. Second, we used parameter estimates from these models along with demographic and income bracket information from the NHIS to calculate an estimate of family income within category for each NHIS respondent. Finally, we grouped individuals in each year of the NHIS into income quartiles. We evaluated the procedure by comparing the March CPS and calculated NHIS income distributions and trends and found they were substantially similar. The appendix provides a complete description of the procedures used.

Non-Hispanic whites are compared to all other racial/ethnic groups combined. There remain substantial differences in culture, socioeconomic status, and other factors within these racial/ethnic groups, but further dis-

2. Prior to 1997 the NHIS considered the respondent to have a disability only if the condition associated with the limitation was chronic or lasted three months. This chronicity restriction is not imposed in the public use disability indicator in 1997 and beyond. Therefore, for the post-1996 data, information in the public use data files that indicates whether the associated condition has lasted at least three months is combined with the disability indicator to mimic the procedure that was used prior to 1997.

aggregation of the minority group led to imprecise estimates. Moreover, comparisons between blacks and nonblacks, and whites and nonwhites led to similar conclusions. Four age groups are considered: seventy to seventy-four, seventy-five to seventy-nine, eighty to eighty-four, and eighty-five and older. Men and women, including currently married and unmarried elderly, are also examined. Finally, geographic disparities are examined for the four regions identifiable in the NHIS public use data: South, West, Midwest, and Northeast.

Unadjusted estimates of the disparities in the prevalence of disability for the population seventy and older are presented graphically for each year 1982 to 2002. The graphs depict trends in the difference in disability for selected groups for each of the socioeconomic and demographic factors. Some factors have too many categories to display the full range of comparisons; for these factors the categories with the highest and lowest disability prevalence in 1982 are shown. For education, for example, the difference in the prevalence for people with zero to eight years and sixteen or more years is displayed for each year. In addition, for each graph a third-order polynomial was fit to the data and displayed.

Two sets of graphs are presented. The first set (fig. 3.3) presents the simple difference in the disability rate across the groups for each year, 1982 to 2002. The second set of graphs (fig. 3.4) presents the relative difference across the groups (i.e., the difference in the disability rate between the group with the highest rate and the group with the lowest rate, divided by the latter, multiplied by 100) across the groups for each year, 1982 to 2002. It is important to consider trends in both measures of the gaps in disability because the disability rate in 1982 is quite different across the socioeconomic and demographic groups.

The second set of graphs is more consistent in approach with the logistic models that are estimated to test for trends and disparities in trends after adjusting for various factors. Statistical tests for adjusted trends and disparities in trends are based on a set of logistic regression models estimated from all years of data combined. The key explanatory factor is a linear trend variable that takes the value of zero in 1982 and increases by 1 in each subsequent year, with maximum value of 20 in 2002. This parsimonious linear specification was adopted because the second- and third-order polynomial terms were not consistently significant. The control variables in all models include age (represented by categories for seventy to seventy-four, seventy-five to seventy-nine, eighty to eighty-four, and eighty-five and older), sex, and indicators for whether the response was given by a proxy. Proxy is also interacted with an indicator for whether the interview was taken after 1996, because the proxy rules in the NHIS changed after 1996.

The first model includes the trend variable along with all of the control variables except age. Model two adds the control for age to demonstrate the importance of age adjustment. The subsequent models, model three through model nine, add the socioeconomic and demographic factors in-

dividually; that is, the direct effect of the factor is included as well as interaction terms between the trend and the variables of interest. A final model includes all of the factors simultaneously.

An estimate of the average annual percent change in disability, the parameter of central interest, is calculated as the estimated odds ratio on the trend variable minus 1, multiplied by one hundred. Tests for differences across groups in the average annual percent change are evaluated by significance levels of interaction terms.

Finally, as a robustness check, all of the multivariate models were reestimated using ordinary least squares (OLS) instead of logistic models. The OLS estimates provide the regression analog of the simple differences reported in figure 3.3. The OLS estimates (appendix table 3.1) lead to the same substantive conclusion as the logistic models. The primary exception to this conclusion is the change in the disparity across age groups, and this point is described when referring to unadjusted disparities in figures 3.3 and 3.4.

3.3 Results

Disparities in health and disability are well documented in the population as a whole, and the magnitude of the disparities in disability for the population age seventy and older are displayed in figure 3.1. That is, the percentage of the population age seventy and older who report needing help with a daily activity in 1982 (the beginning of our time period) is displayed for each of the socioeconomic and demographic factors. Appendix table 3.2 reports the proportion of this population that falls into each of these groups in each year.

Socioeconomic differentials (panel A) are large, with disability rates of 27 percent for people with zero to eight years versus 15 percent for people with sixteen or more years. The lowest income quartile has a disability rate that is 38 percent higher than the highest income quartile (29 versus 21 percent), with similar differences between non-Hispanic whites and all other racial/ethnic groups.

Demographic disparities in disability are also substantial. The disparities in favor of men over women (8 percentage points), married over not married (11 percentage points), and residents in the West over the South (10 percentage points) are all at least as large as the disparity that exists for the highest versus the lowest income quartiles. Obviously age is strongly related to disability, with a rate of 15 percent for the seventy to seventy-four year-old age group and 42 percent for those ages eighty-five and older.

Unadjusted trends in old-age disability are reported in figure 3.2. At the beginning of the period, 22.7 percent had either an ADL or IADL disability. There was a steep drop in the subsequent five years, but then the rate was virtually unchanged for the next ten years, 1986 to 1996. The rate fell quickly during the following six-year period, from 19.3 percent in 1996 to

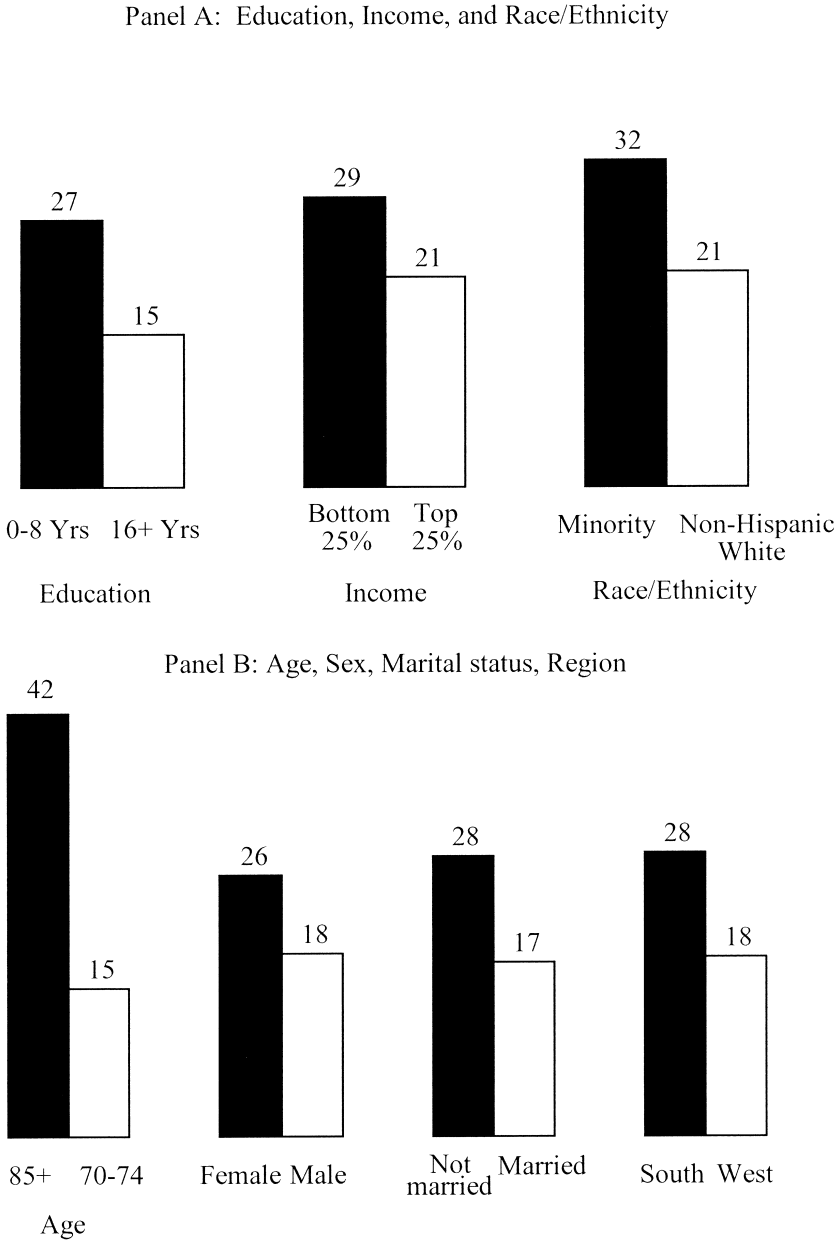

Fig. 3.1 Percent of the population seventy and older who have a disability, by socioeconomic and demographic characteristics: 1982

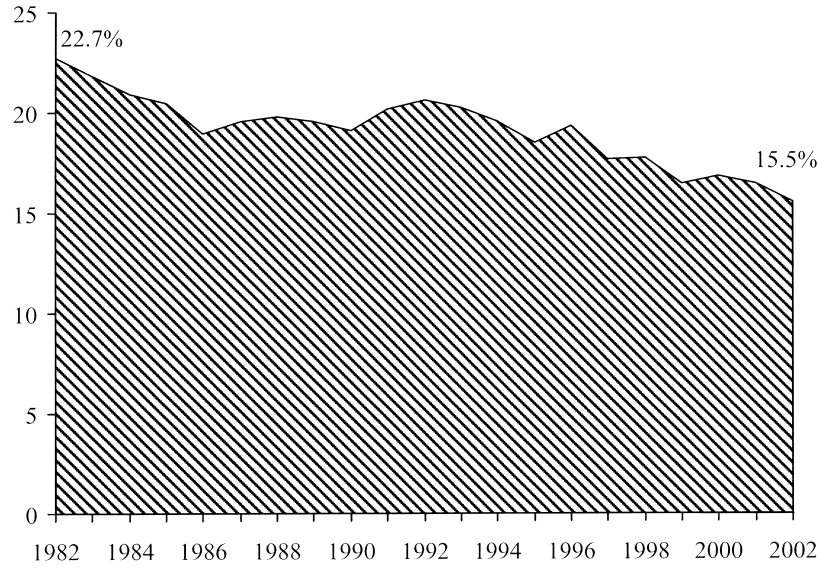

Fig. 3.2 Percent of the population seventy and older who have a disability: 1982 to 2002

15.5 percent in 2002. Taken as a whole, the 32 percent reduction in disability (i.e., 7.2 percentage point decline divided by 22.7 percent disability rate in 1982) over the twenty year period translates into a–1.39 percent annual change in disability.

Figure 3.3 displays the difference in the percentage that have a disability between the groups with the highest and lowest disability rates in 1982. For example, at the beginning of the period people with zero to eight years of schooling were roughly 10 percentage points more likely to have a disability than were people with sixteen or more years of schooling. The disparity increased to nearly 15 percentage points by the end of the twenty year period. Income disparities were smaller than the educational disparity but experienced a roughly similar increase through 2002. At the same time, racial/ethnic disparities were cut in half, from about 10 percentage points to 5 percentage points.

Disparities by age and sex were fairly constant during the twenty year period. The advantage in favor of married people shows a modestly increasing trend through 2002. Regional differences declined, specifically between the South and the West. The South had the highest disability rate in 1982—a rate that was 10 percentage points higher than in the West—but this gap was eliminated by 2002. During this period, the seventy-and-older population shifted toward both of these regions by somewhat similar magnitudes and away from the Northeast and Midwest (appendix table 3.2).

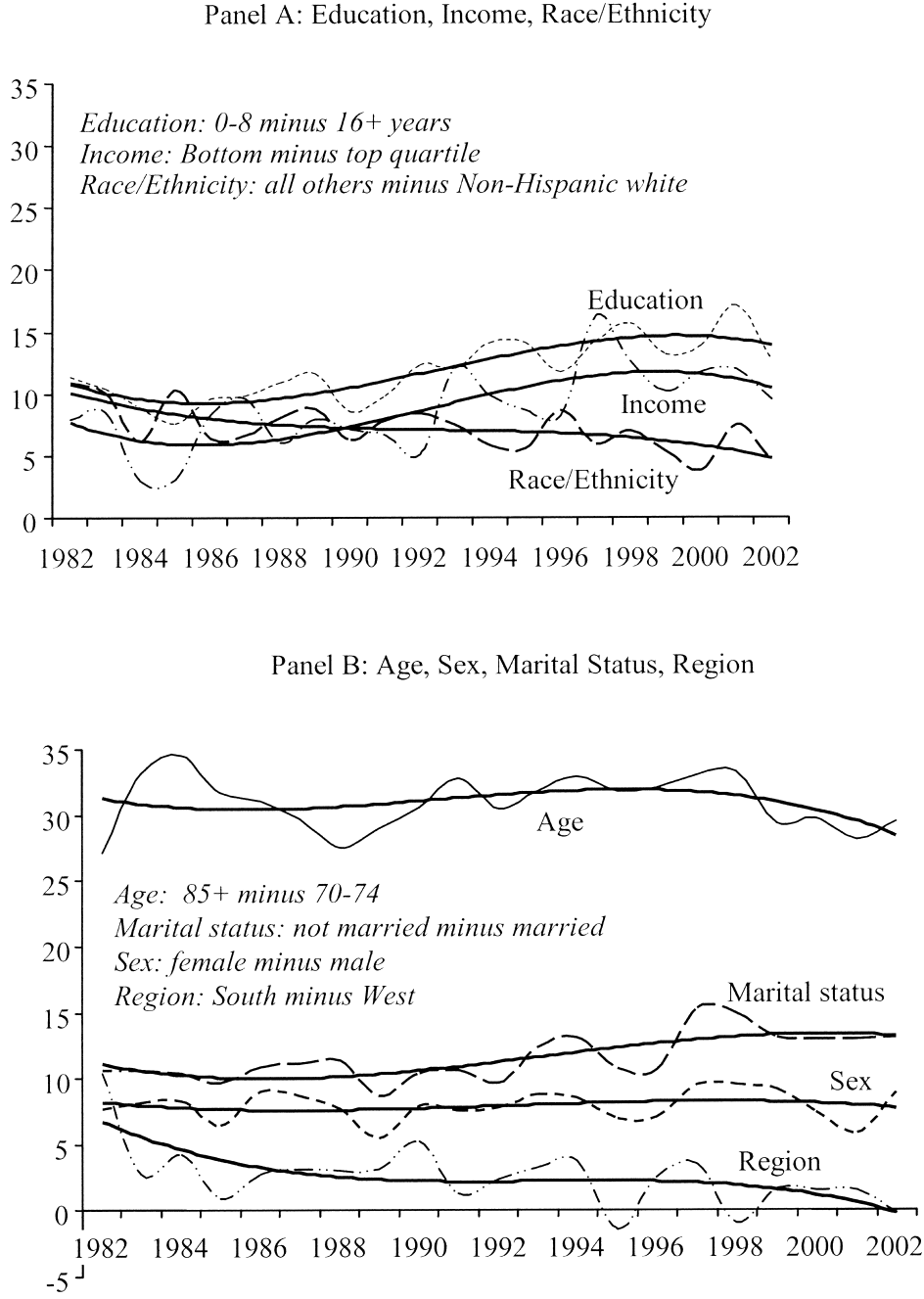

Fig. 3.3 Unadjusted difference in the disability rate: Low versus high socioeconomic and demographic groups: 1982 to 2002

Note: In each year for each variable, the disability rate for the category with the lowest rate (as of 1982) is subtracted from the rate for the category with the highest rate (as of 1982). A cubic trend is displayed on top of estimates for each factor.

The trends in relative disability (fig. 3.4) are similar to the trends in the simple difference in disability (fig. 3.3). That is, regardless of the measure of disparity in disability, the differences by education, income, and marital status increased, and the differences by region decreased. The most notable exception is for age. There was little change in the simple difference in disability prevalence across age groups, but because the disability rate is much lower for the younger age groups, the relative difference increased substantially, which indicates a widening gap. Specifically, the disability rate in 1982 was roughly 200 percent higher for people eighty-five and older than people seventy to seventy-four. But the gap increased to nearly 400 percent by 2002 (fig. 3.4). The trend in the gap between racial/ethnic groups is also somewhat sensitive to whether relative or simple differences are examined; both measures indicate some decline in the racial/ethnic gap, but the simple difference measure in figure 3.3 shows a larger decline than the relative difference measure, which is expected, given the fact that minorities experienced a larger absolute decline in disability than non-Hispanic whites over the twenty year period.

3.3.1 Multivariate Analyses

The estimates from model one in table 3.1 replicate the graphical analysis in figure 3.4 but control for sex and proxy response and parameterize the trend as linear. The odds ratio of 0.9845 implies an annual change of –1.55 percent per year ([0.9845–1.0] × 100), which is close to the unadjusted estimate of –1.39 percent based on the change in the prevalence at the endpoints 1982 and 2002, discussed previously.

The age distribution of the population seventy and older became only slightly older. However, because of the strong relationship between age and disability, adjusting for age (model two versus model one) increases (in absolute value terms) the estimated rate of change in disability to –2.15 percent per year. The estimate is also very precise, with the 95 percent confidence interval ranging from 0.9751 to 0.9820, or in average annual percentage terms from –1.80 to –2.49.

The multivariate estimates are consistent with the graphical depiction of the trends in disparities between education and income groups. The odds ratios imply a larger decline for the higher income and education groups. For example, the lowest education group experienced a change of just –0.88 percent per year, while the most educated group experienced a change of –2.53 percent per year. Moreover, the trend exhibits an almost fully monotonic increase with education and income; at all levels, the higher the education and income, the greater the decline. The differences between the higher groups and the lowest group are statistically significant and substantively important in most cases as well.

The age-adjusted decline is somewhat greater for minorities than for non-Hispanic whites, although the difference is not statistically significant.

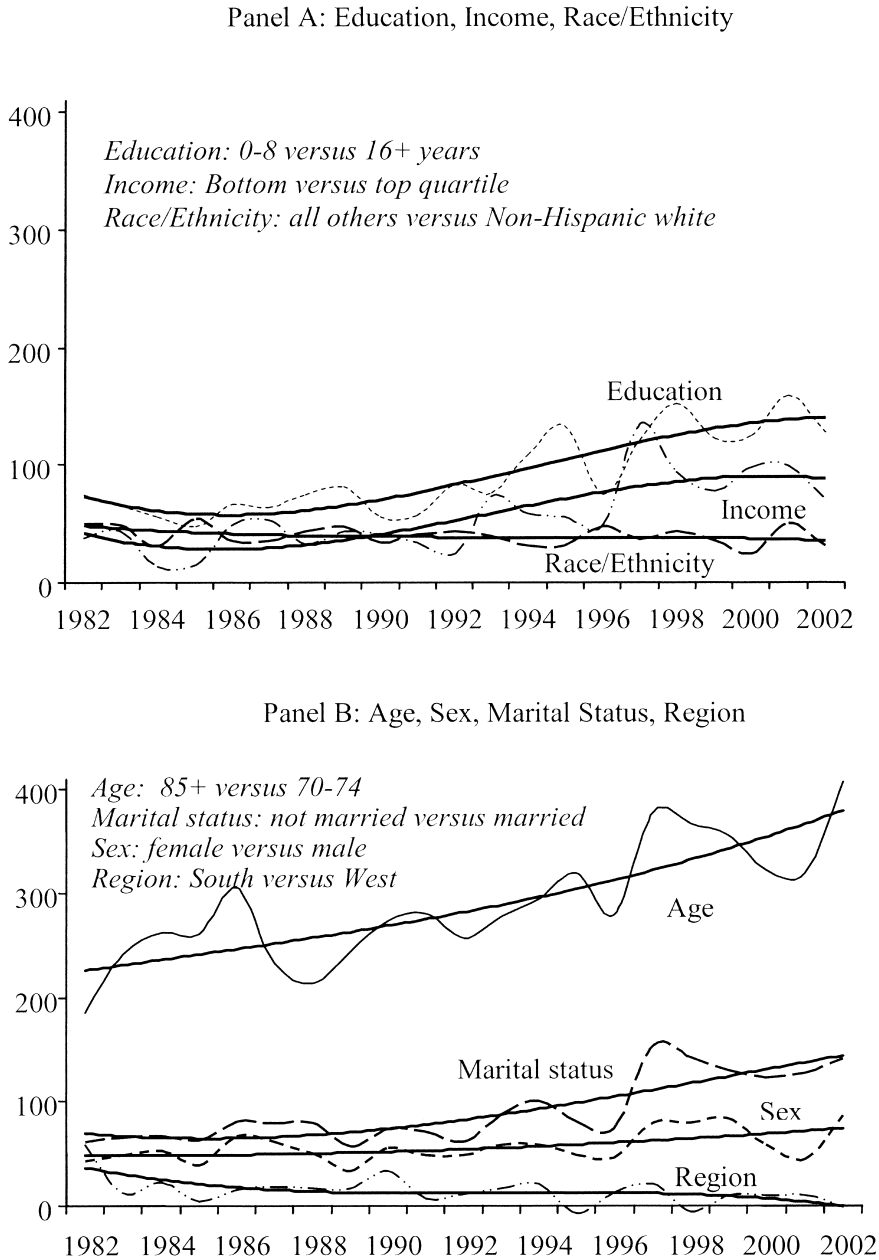

Fig. 3.4 Unadjusted relative disability rate: Low versus high socioeconomic and demographic groups: 1982 to 2002

Note: In each year for each variable, the difference between the disability rate for the category with the highest rate (as of 1982) and the disability rate for the category with the lowest rate (as of 1982) is divided by the rate for the latter category, and multiplied by 100. A cubic trend is displayed on top of estimates for each factor.

Table 3.1 **Odds ratios from logistic models allowing trend to differ by socioeconomic and demographic characteristics**

	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Trend	0.9845	0.9811–0.9879	0.9785	0.9751–0.9820						
Trend * Education										
0–8 years					0.9912	0.9862–0.9962				
9–41 years					0.9916	0.9852–0.9981				
12 years					0.9839**	0.9789–0.9891				
13–15 years					0.9833*	0.9756–0.9911				
16+ years					0.9747***	0.9669–0.9826				
Trend * Income										
Quartile 1							0.9862	0.9812–0.9912		
Quartile 2							0.9735***	0.9679–0.9791		
Quartile 3							0.9694***	0.9639–0.9750		
Quartile 4							0.9689***	0.9634–0.9744		
Trend * race/ethnicity										
Non-Hispanic white									0.9782	0.9747–0.9818
All others									0.9743	0.9675–0.9811
Controls										
Age 75–79			1.5855	1.5275–1.6457	1.5415	1.4853–1.5999	1.5533	1.4963–1.6124	1.6000	1.5411–1.6610
Age 80–84			2.8030	2.6937–2.9167	2.6464	2.5424–2.7546	2.6901	2.5837–2.8008	2.8487	2.7372–2.9648
Age 85+			5.6906	5.4451–5.9472	5.1957	4.9685–5.4332	5.3614	5.1291–5.6043	5.8057	5.5553–6.0675
Female	1.8859	1.8302–1.9433	1.7403	1.6874–1.7949	1.7475	1.6943–1.8023	1.6437	1.5927–1.6963	1.7329	1.6802–1.7873
Any Proxy	1.9600	1.8812–2.0421	1.9596	1.8823–2.0401	1.9178	1.8415–1.9973	2.1526	2.0683–2.2403	1.9140	1.8388–1.9924
Any Proxy * Post-1996	0.6723	0.6291–0.7184	0.6955	0.6517–0.7422	0.6902	0.6465–0.7368	0.7673	0.7178–0.8202	0.6952	0.6514–0.7420
DK Proxy	1.4411	1.2212–1.7006	1.3228	1.1092–1.5776	1.1356	0.9455–1.3638	1.3112	1.0943–1.5712	1.3027	1.0920–1.5540
DK Proxy * Post-1996	0.6602	0.3156–1.3810	0.8961	0.3967–2.0243	1.0167	0.4603–2.2455	1.1140	0.4969–2.4976	0.8533	0.3754–1.9400
Main effects										
Education 9–11 years					0.7696	0.7113–0.8327				
Education 12 years					0.6486	0.6038–0.6967				
Education 13–15 years					0.6148	0.5524–0.6844				
Education 16+ years					0.6467	0.5779–0.7237				
Income quartile 2							0.7594	0.7060–0.8169		
Income quartile 3							0.7200	0.6646–0.7800		
Income quartile 4							0.7112	0.6541–0.7733		
Non–Hispanic whites									0.6024	0.5493–0.6605

(*continued*)

Table 3.1 (continued)

	Model 6		Model 7		Model 8		Model 9	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Trend * Age								
Age 70–74	0.9720	0.9667–0.9773						
Age 75–79	0.9742	0.9691–0.9792						
Age 80–84	0.9812***	0.9758–0.9867						
Age 85+	0.9893***	0.9839–0.9947						
Trend * Sex								
Female			0.9795	0.9759–0.9831				
Male			0.9763	0.9713–0.9813				
Trend * Marital status								
Married					0.9596	0.9547–0.9646		
Not married					0.9864***	0.9828–0.9901		
Trend * Interview region								
South							0.9722	0.9662–0.9782
Northeast							0.9768	0.9703–0.9854
Midwest							0.9836***	0.9774–0.9899
West							0.9846***	0.9778–0.9914
Controls								
Age 75–79	1.5541	1.4518–1.6637	1.5857	1.5277–1.6459	1.5244	1.4684–1.5824	1.5884	1.5303–1.6488
Age 80–84	2.5511	2.3603–2.7573	2.8035	2.6942–2.9172	2.5648	2.4637–2.6700	2.8131	2.7034–2.9273
Age 85+	4.7250	4.3412–5.1429	5.6908	5.4453–5.9474	4.8483	4.6358–5.0707	5.7415	5.4935–6.0006
Female	1.7412	1.6884–1.7958	1.6830	1.5923–1.7789	1.4396	1.3937–1.4871	1.7438	1.6909–1.7984
Any Proxy	1.9622	1.8851–2.0425	1.9556	1.8777–2.0368	2.1337	2.0480–2.2231	1.9539	1.8770–2.0339
Any Proxy * Post-1996	0.6967	0.6528–0.7437	0.6990	0.6543–0.7467	0.8102	0.7572–0.8670	0.6974	0.6535–0.7442
DK Proxy	1.3294	1.1154–1.5844	1.3229	1.1093–1.5776	1.2836	1.0766–1.5304	1.3098	1.0947–1.5672
DK Proxy * Post-1996	0.9087	0.3979–2.0752	0.8973	0.3969–0.2084	1.0985	0.4833–2.4966	0.8937	0.3940–2.0272
Married					0.7775	0.7313–0.8266		
Northeast region							1.0026	0.8842–1.1367
Midwest region							1.0120	0.8997–1.1382
South region							1.3652	1.2150–1.5340

Notes: OR = Odds Ratio; CI = Confidence Interval; DK = Do not know; N = 172,227. Sample is all persons aged seventy (seventy-one in 1982) and older in the NHIS. To account for the complex nature of the sample design, variance estimation was conducted using SUDAAN software. Reference groups for models 1–5 are: zero to eight years, quartile 1, "all others." Reference groups for models 6–9 are: seventy to seventy-four, female, married, South. *, **, *** indicate a statistical significant trend relative to the trend for the reference group at the 0.10, 0.05, and 0.01 level, respectively.

While changes were substantial for the older age groups (–1.07 percent per year for people eighty-five and older) the declines were much larger for the younger group. The rate of change was –2.80 percent and –2.58 percent per year for the two youngest groups, respectively.

For the population seventy and older between 1982 and 2002, male mortality improved more than female mortality. If it were the case that the relatively strong improvements for males resulted in keeping alive people who had a disability, then it would be expected that disability declines would be greater for women. But this is not the case; the declines in disability are not statistically significantly different between the sexes.

The changes are much larger among married elderly: –4.04 percent versus –1.36 percent per year for the unmarried. Recall that these estimates adjust for the direct effect of marriage, and the marital status distribution did not change substantially during the twenty years. The South has the highest initial disability rate among the four regions, but it is also the region that experienced the largest declines in disability.

All factors simultaneously.

Can the trends for various groups be explained by changes in the composition of the sample over the twenty-year period? We explore this issue by estimating models identical to those in table 3.1, but for each model add controls for the direct effects of all of the socioeconomic and demographic factors. The first column of table 3.2 replicates the estimates reported in table 3.1, but instead of reporting the odds ratio it reports the average annual percentage change in disability (i.e., the odds ratio minus 1, multiplied by 100). Each set of rows separated by a horizontal line is based on its own logistic model, as in table 3.1. The second column contains the estimate of the average annual percentage change based on the models that include the additional factors. For example, the average annual percentage change without controlling for any factors other than age, sex, and proxy is –2.15. If all of the socioeconomic and demographic factors are accounted for, the change is reduced to –1.86. In logistic models not reported in the tables, it was found that education accounted for virtually all of the change in the estimate.

The estimated changes in disability for most socioeconomic and demographic groups were not altered substantially when the additional factors were accounted for. For example, the trend for people seventy to seventy-four is –2.80 without additional controls and –2.63 with additional controls. For income, the trends are slightly lower for each group when controls are added, but all trends remain statistically significant, and the trend for the two highest income quartiles remains more than twice as large as the decline among the lowest income quartile. For education, trends are strengthened for each group, with especially large increases for the least educated: the change is –0.88 without controls and –1.52 with controls. Again, however,

Table 3.2 **Estimated average annual percent change in disability controlling for all socioeconomic and demographic factors simultaneously**

	Based on estimates reported in models 2–9 in Table 3.1 (1)	Same as (1) but also controls for direct effect of all socioeconomic and demographic factors (2)
Trend	–2.15	–1.86
Trend * Education		
0–8 years	–0.88	–1.52
9–11 years	–0.84	–1.35
12 years	–1.61**	–1.92
13–15 years	–1.67*	–2.01
16+ years	–2.53***	–2.85***
Trend * Income		
Quartile 1	–1.38	–1.10
Quartile 2	–2.65***	–2.05***
Quartile 3	–3.06***	–2.57***
Quartile 4	–3.11***	–2.34***
Trend * Race/ethnicity		
Non-Hispanic white	–2.18	–1.76
All others	–2.57	–2.36***
Trend * Age		
Age 70–74	–2.80	–2.63
Age 75–79	–2.58	–2.22
Age 80–84	–1.88***	–1.40***
Age 85+	–1.07***	–0.91***
Trend * Sex		
Female	–2.05	–1.78
Male	–2.37	–2.03
Trend * Marital Status		
Married	–4.04	–3.41
Not married	–1.36***	–1.10***
Trend * Interview region		
South	–2.78	–2.39
Northeast	–2.32	–1.99
Midwest	–1.64***	–1.18***
West	–1.54***	–1.56*

Notes: All models include controls for age, sex, and proxy factors listed in table 3.1. All estimates of trends are significant at the 0.05 level. Reference groups are: zero to eight years, quartile 1, non-Hispanic white, seventy to seventy-four female, married, South. Estimates in each set of rows are based on a separate logistic model. *, **, *** indicate a statistical significant trend relative to the trend for the reference group at the 0.10, 0.05, and 0.01 level, respectively.

the declines are much larger for those with more education. However, statistically significant racial/ethnic differences in trends in favor of minorities emerge once the other controls are added. And declines in disability among older people living in the South remain significantly greater than those for people living in the West and Midwest.

3.3.2 Institutionalized Population

We explored sensitivity to the omission of the institutional population using data from the National Nursing Home Survey (NNHS). The NNHS is used to add in the nursing home population to the estimates based on the noninstitutional population from the NHIS. One of the limitations of this approach is that some assisted living facilities are most likely not included in either the NHIS or the NNHS. Although the exact number of elderly persons living in such facilities is unknown, it is believed to be small but increasing.

Table 3.3 displays the disability rate for the noninstitutional population (NHIS) and for the noninstitutional population combined with the nursing home population (NHIS+NNHS) in each year in which the NNHS was conducted: 1985, 1995, 1997, and 1999. The NNHS does not contain data on income and education of nursing home residents, but race/ethnicity, age, sex, marital status, and region are measured. All of the underlying estimates that are needed to combine the NHIS and NNHS estimates into a single estimate are contained in table 3.3 for the entire population seventy and older, and, as an illustration, for the two racial/ethnic groups. In calculating these estimates, it is assumed that all nursing home residents have either an ADL or IADL disability.

The central issue is whether the trends in disparities in disability are different when the nursing home population is folded into the estimates of disability. This is addressed in figures 3.5 and 3.6, which display the exact same disparities displayed in figures 3.3 and 3.4 for the population living in the community (i.e., the NHIS estimates), but also shows the disparities after the nursing home population is included into the analysis. The general finding is that adding in the nursing home population does not alter the estimated trend in disparities. For example, the cubic trend in the gap between racial/ethnic groups based on the estimates from the community-dwelling sample in the NHIS (fig. 3.5) runs almost exactly through the large square data points representing the racial/ethnic disparity once the nursing home population is included. The disparities by marital status and age are larger when the nursing home population is included, which is exactly what would be expected given the fact that unmarried and older persons are much more likely to be living in nursing homes than married and younger persons. However, the trends in disparities are quite similar regardless of the inclusion of the nursing home population: the disparity between the married and unmarried increased between 1985 and the later periods; dispari-

Table 3.3 **Disability rate with and without the nursing home population included, by race/ethnicity**

	All Persons			Non-Hispanic white			All other racial/ethnic groups		
	Number of people	Number with any disability	Proportion with any disability	Number of people	Number with any disability	Proportion with any disability	Number of people	Number with any disability	Proportion with any disability
				National Nursing Home Survey (NNHS)					
1985	1,234,301	1,234,301	1.0000	1,119,917	1,119,917	1.0000	114,383	114,383	1.0000
1995	1,359,583	1,359,583	1.0000	1,137,779	1,137,779	1.0000	221,804	221,804	1.0000
1997	1,403,624	1,403,624	1.0000	1,153,462	1,153,462	1.0000	250,163	250,163	1.0000
1999	1,396,921	1,396,921	1.0000	1,144,488	1,144,488	1.0000	252,434	252,434	1.0000
				National Health Interview Survey (NHIS)					
1985	17,753,893	3,627,120	0.2043	15,666,083	3,011,021	0.1922	2,087,810	616,530	0.2953
1995	21,689,083	4,016,818	0.1852	18,659,629	3,310,218	0.1774	3,029,454	706,772	0.2333
1997	22,410,160	3,959,875	0.1767	19,258,332	3,114,072	0.1617	3,151,828	697,500	0.2213
1999	23,286,508	3,821,316	0.1641	19,795,256	2,969,288	0.1500	3,491,252	711,168	0.2037
				NNHS + NHIS					
1985	18,988,194	4,861,421	0.2560	16,786,000	4,130,938	0.2461	2,202,193	730,914	0.3319
1995	23,048,666	5,376,401	0.2333	19,797,408	4,447,997	0.2247	3,251,258	928,576	0.2856
1997	23,813,784	5,363,499	0.2252	20,411,794	4,267,534	0.2091	3,401,991	947,662	0.2786
1999	24,683,429	5,218,237	0.2114	20,939,744	4,113,776	0.1965	3,743,686	963,602	0.2574

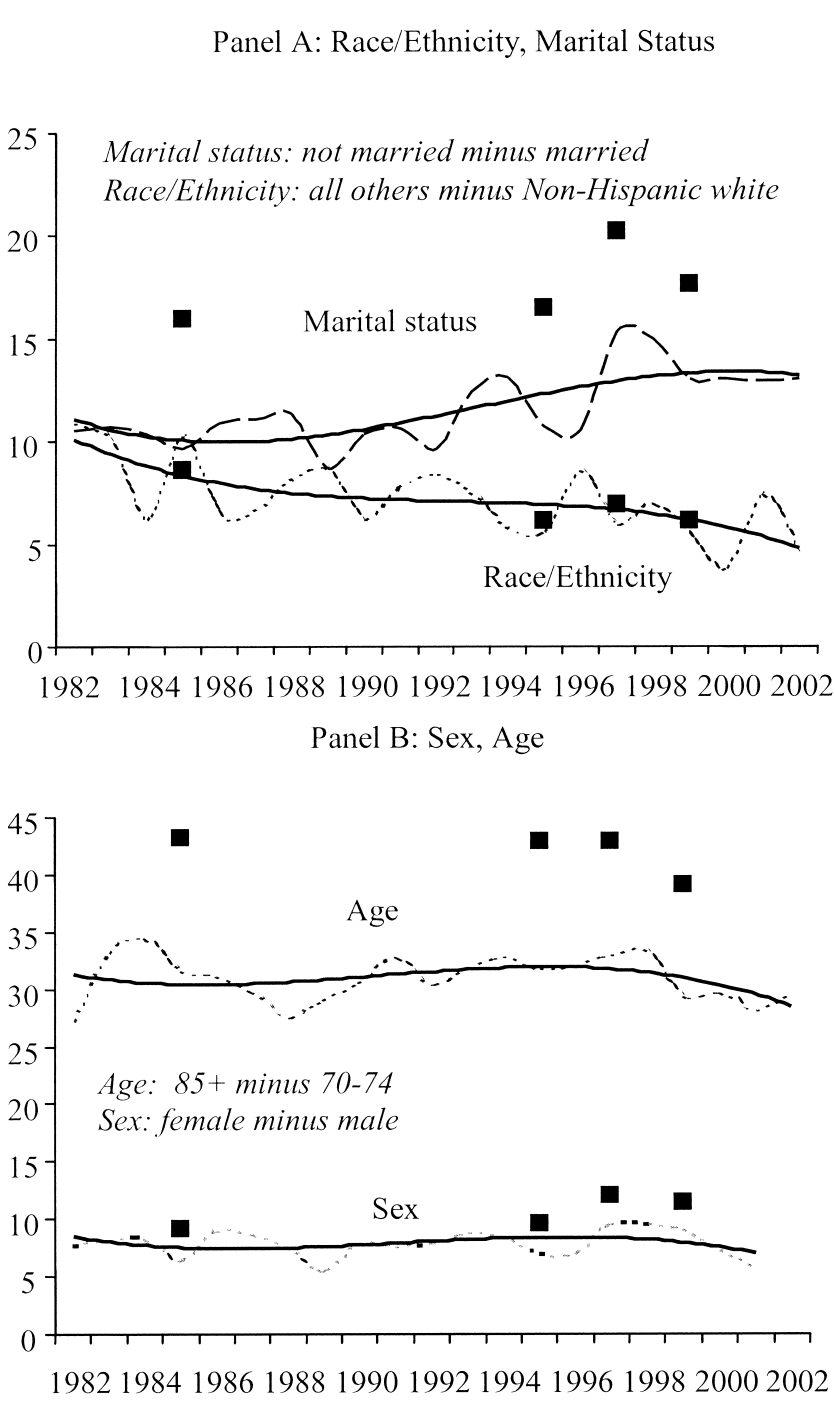

Fig. 3.5 Unadjusted difference in disability rate with and without the nursing home population: 1982 to 2002

Note: In each year for each variable, the disability rate for the category with the lowest rate (as of 1982) is subtracted from the rate for the category with the highest rate (as of 1982). A cubic trend is displayed on top of estimates for each factor. Square marks = with nursing home population; dashed lines = without nursing home population.

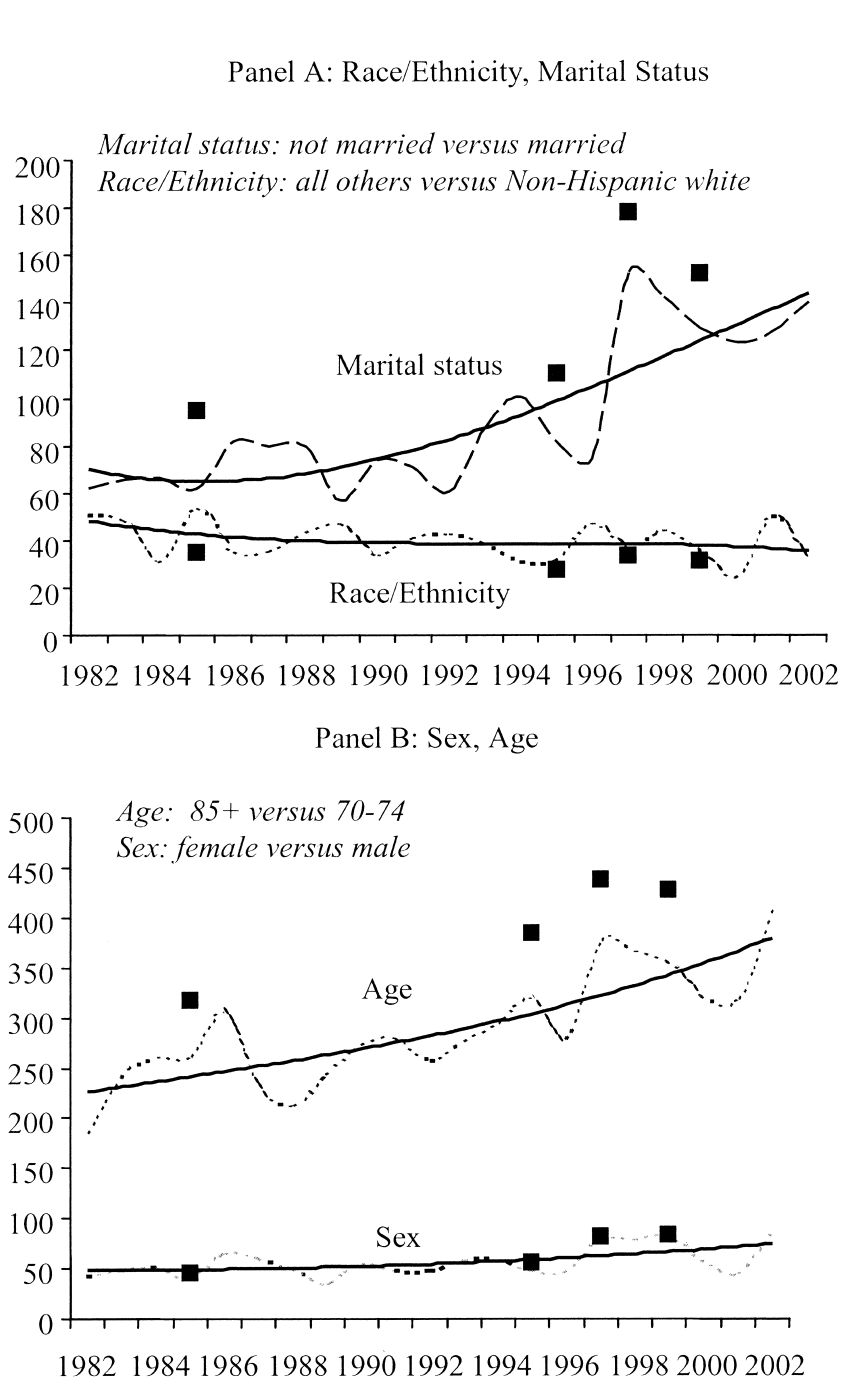

Fig. 3.6 Unadjusted relative disability rate with and without the nursing home population: 1982 to 2002

Note: In each year for each variable, the difference between the disability rate for the category with the highest rate (as of 1982) and the disability rate for the category with the lowest rate (as of 1982) is divided by the rate for the latter category, and multiplied by 100. A cubic trend is displayed on top of estimates for each factor. Square marks = with nursing home population; dashed lines = without nursing home population.

ties between non-Hispanic whites and all others did not increase and showed some signs of declining, although the estimates were not significant; disparities between men and women changed very little; when measured by the simple difference in disability rates, age disparities were flat between 1985 and 1997 and then fell somewhat, but when measured by the relative differences the age disparities increased (fig. 3.6).

3.4 Discussion

Old-age disability rates among all socioeconomic and demographic groups declined over the past two decades, but the magnitude of the decline was larger for several groups with lower risk of having disability—those who had higher income, had more years of education, were married, and were younger. As a result, disparities in disability generally have increased.

Two noteworthy exceptions involve regional and racial/ethnic patterns. First, once all other factors were controlled, there was a narrowing of the disability disparity between non-Hispanic whites and others. Second, because declines were greatest in the southern states, gaps in disability between the South and West and between the South and Midwest narrowed over this time period.

These findings extend previous studies of trends in disability gaps in several ways. Prior studies have typically limited exploration of gaps to disparities by age, sex, race, and education and have often omitted important statistical tests (Freedman, Martin, and Schoeni 2002). The only study to consistently include statistical tests (Schoeni, Freedman, and Wallace 2001) drew upon the same dataset we use here (the NHIS), but was limited to fifteen years, from 1982 to 1996. In that analysis it was found, as we find here, that educational and marital status differences were widening and regional differences narrowing over time. Unlike that prior analysis, however, we have here documented growing disparities by income quartiles, narrowing of racial gaps, and relative increases in the age gap.

What has caused these trends? Our analysis suggests that trends cannot be attributed to changes in the size or makeup of the nursing home population. And, with the exception of age disparities, we find trends and disparities therein are robust whether we consider absolute differences in prevalence across groups or relative differences. Nor can we attribute declines completely to shifts in the demographic composition of the older population. Indeed, we found that sociodemographic and economic factors are highly correlated with disability in old age, and along many of these dimensions the composition of the older population has changed. Population groups that have lower disability rates—those who are married, male, more educated, and for example—have become more prevalent among the elderly. But we find that together, changes in these factors and others explain little of the net improvement in disability.

We also find, like others (Freedman and Martin 1999; Waidmann and Liu 2000), that shifts in the education distribution in particular explain a substantial portion (but not all) of the decline in disability. Education may represent, among other things, the lifelong effects of mediating factors including early childhood experiences, access to medical care throughout the lifecourse, health behaviors, and ability to navigate the health care system and implement complex medical regimens. To identify the causes of the declines in disability and shifts in the gaps we must look to these mediating effects as well as other factors not directly linked to educational attainment.

Late-life disability is influenced by a variety of factors, many of which are modifiable and are linked to demographic characteristics and socioeconomic status (Stuck 1999). Here we speculate about the relevance of three domains: behavioral and biologic risk factors, medical care, and the physical environment. These factors may assert their effects in different stages of the lifecourse, including early life and midlife (Barker 1994; Blackwell, Hayward, and Crimmins 2001; Elo and Preston 1992; Kuh and Ben-Shlomo 1997).

Risk factors for lifestyle-related diseases have been linked to disability and have been shown to vary by demographic and socioeconomic status (Berkman and Mullen 1997; DeLew and Weinick 2000). The contribution of risk factors to trends has been explored for the adult population in other countries (Ahacic et al. 2007; Galobardes et al. 2003), where increases in socioeconomic status have been linked to declines in disability through mediating health behaviors and biologic risk factors. To our knowledge, in the United States nationally representative population-based evidence linking trends in risk factors to late-life disability for various demographic and socioeconomic groups is not available. However, insight into this relationship may be gleaned from more selective studies and from studies with too few older people to stratify by demographic and socioeconomic status. For example, Allaire and colleagues (1999) show for the (largely white) Framingham Heart Study that offspring have fewer risk factors for disability (i.e., were more physically active and less likely to smoke or consume high amounts of alcohol) than their parents. Vita and colleagues (1998) have demonstrated for a cohort of college graduates that individuals with a low-risk profile in terms of smoking, body mass index, and exercise patterns live longer and experience fewer years of disability compressed at the end of life. At the same time, data from the fifty state Behavioral Risk Factor Surveillance System suggests health-related quality of life and self-rated health status has improved for people ages sixty-five and older (Zack et al. 2004) despite worsening trends for other age groups. Analysis of changes in health behaviors between 1990 and 2000 suggest that older Americans in 2000 were more likely to exercise, consume more fruits and vegetables daily, and to have recently obtained a routine medical checkup and less likely to smoke tobacco or drink any alcohol (Mokdad et al. 2004).

Another domain of speculation that may be particularly relevant is

changes in the use of medical care. There also are important differentials, for example, in access to medical care and health care information (AHRQ 2003). Although few studies provide evidence of gaps over time in medical care, limited evidence is available on trends by race and on cross-sectional patterns by region. Escarce and McGuire (2004), for example, find that between 1986 and 1997 the white–black gap in use of medical procedures and diagnostic tests under Medicare narrowed. Findings have been mixed, however, with respect to specific medical procedures and services. For example, Groeneveld, Heidenreich, and Garber (2005) found declines in racial disparities in the use of implantable cardiac defribillators, while Crystal and colleagues (2003) found increases in depression treatment were larger for whites than for Hispanics. Regional variation in medical care is substantial, even for narrowly defined conditions (Baicker et al. 2004; Wennberg and Cooper 1999; Weinstein et al. 2004). Fisher and colleagues (2003) find that per capita Medicare spending is particularly high for hospital referral areas in the southern region, and Lin and Zimmer (2002) have identified higher rates of disability in southern states, but how these patterns have changed over the last two decades and whether they are linked needs further exploration.

Changes over time in the physical environment in which older people live and work may also be influencing disability rates differentially by demographic and socioeconomic status. Less advantaged groups often live in poorer-quality older housing and face more environmental barriers (Gitlin et al. 2001; Tomita et al. 1997; Newman 2003) and are less likely to turn to assistive technologies for difficulty with daily activities (Agree, Freedman and Sengupta 2004). At the same time, socioeconomically advantaged groups are more likely to live in homes with features in place that facilitate aging (e.g., retirement communities built with wide hallways, railings, and accessible bathrooms). Recent studies suggest a strong trend toward the use of assistive technology as the sole form of assistance—that is, without help from another person (Freedman et al. 2004; Spillman 2004)—and increases in the presence of home modifications among older people reporting a housing-related disability. Differentials in these trends have been explored for the first time elsewhere in this volume by Freedman and colleagues, who show that disparities in assistive technology use by race and socioeconomic status have persisted through 2001. They also show, however, that only among those with more than a high school education have increases in assistive technology offset declines in the chances of receiving help. Such evidence is consistent with the divergent disability trends by education we found here.

Understanding the underlying cause of the disparities in disability and the reasons for the changes in this gap are pressing social and policy concerns. The causal factors are likely to consist of a mixture of medical, social, and behavioral influences. Interdisciplinary teams are needed to make significant headway on these unresolved issues. Moreover, a broad population-

level perspective, as opposed to focusing on a single cause or subgroup, is likely to be a more effective approach.

Appendix

Income Quartile Estimation

To determine a value for total family income for the NHIS 1982–2002 person data, we used the following imputation method. A regression model of total family income was estimated using the March Current Population Survey (CPS) data for each year, 1982–2002, for persons aged seventy and older. The March CPS is the Census Bureau's official source for income and poverty estimates. The explanatory variables include characteristics measured in both the CPS and the NHIS: age, years of education completed, ethnicity and race, marital status, sex, region, and family size. In addition, dummy variables were constructed to reflect whether a respondent was in a given income bracket, with the income brackets being the NHIS-defined categories. For 1982–1996 there were twenty-six NHIS income brackets and for 1997–2002 there were eleven. Years of education were grouped into three categories: zero to eight years, nine to twelve years, and thirteen and over years. Hispanic ethnicity and race were combined to form four categories: Hispanic, non-Hispanic whites, non-Hispanic blacks, and non-Hispanic other. Four variables represented family size: 1, 2, 3, and 4 or more. Region was defined as Northeast, Midwest, South, and West. All sociodemographic factors were interacted with the income brackets when the width of the bracket was not equal to $5,000. For example, for years 1982–1996, interactions were included for family income between $20,000 and $49,999, family income of $50,000 or over, and family income over $20,000. For years 1997–2002, interactions were included for family income between $25,000 and $74,999, family income of $75,000 or more, and family income over $20,000.

The NHIS person data contain some missing observations for total family income. Therefore, a separate model was estimated that had all of the explanatory variables previously described except the income categories, since these were unknown in the NHIS for some NHIS respondents.

Finally, using the parameter estimates from the CPS models for each year, a predicted income value was generated for each person in the NHIS sample. After calculating the predicted value of total family income for each respondent in the NHIS, tests were run to determine if the predicted value fell within the NHIS-defined income bracket that they reported. For all but five of the 172,227 cases estimated, income values fell within the actual reported income bracket.

Table 3A.1 OLS regression allowing trend to differ across socioeconomic and demographic factors

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Trend	–0.0023	0.0003	–0.0030	0.0003						
Trend * Education										
0–8 years					–0.0014	0.0004				
9–11 years					–0.0011	0.0005				
12 years					–0.0021	0.0003				
13–15 years					–0.0020	0.0005				
16+ years					–0.0026	0.0005**				
Trend * Income										
Quartile 1							–0.0022	0.0004		
Quartile 2							–0.0035	0.0004**		
Quartile 3							–0.0038	0.0004***		
Quartile 4							–0.0038	0.0004***		
Trend*Race/ethnicity							–0.0038	0.0004***		
Non-Hispanic white									–0.0030	–0.0003
All others									–0.0044	0.0006**
Controls										
Age 75–79			0.0523	0.0022	0.0480	0.0021	0.0492	0.0022	0.0533	0.0022
Age 80–84			0.1426	0.0031	0.1332	0.0031	0.1359	0.0031	0.1443	0.0031
Age 85+			0.2963	0.0042	0.2803	0.0042	0.2859	0.0042	0.2979	0.0042
Female	0.0911	0.0021	0.0752	0.0021	0.0753	0.0021	0.0661	0.0021	0.0744	0.0021
Any proxy	0.1105	0.0039	0.1046	0.0035	0.1003	0.0035	0.1156	0.0035	0.1011	0.0035
Any proxy * Post-1996	–0.0705	0.0055	–0.0619	0.0051	–0.0620	0.0050	–0.0526	0.0051	–0.0611	0.0050
DK proxy	0.0581	0.0148	0.0426	0.0147	0.0138	0.0151	0.0407	0.0149	0.0402	0.0146
DK proxy * Post-1996	–0.0618	0.0463	–0.0138	0.0479	0.0103	0.0468	0.0105	0.0477	–0.0197	0.0480
Main effects										
Education 9–11 years					–0.0467	0.0063				
Education 12 years					–0.0698	0.0055				
Education 13–15 years					–0.0775	0.0074				
Education 16+ years					–0.0732	0.0079				
Income quartile 2							–0.0500	0.0060		
Income quartile 3							–0.0578	0.0064		
Income quartile 4							–0.0583	0.0068		
Non-Hispanic whites									–0.0862	0.0081

(*continued*)

Table 3A.1 (continued)

	Model 1		Model 2		Model 3		Model 4	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Trend * Age								
Age 70–74	–0.0025	0.0003						
Age 75–79	–0.0034	0.0003**						
Age 80–84	–0.0036	0.0005**						
Age 85+	–0.0029	0.0006						
Trend * Sex								
Female			–0.0033	0.0003				
Male			–0.0026	0.0003**				
Trend * Marital Status								
Married					–0.0044	0.0003		
Not married					–0.0022	0.0003***		
Trend * Interview Region								
South							–0.0041	0.0005
Northeast							–0.0031	0.0005
Midwest							–0.0023	0.0004***
West							–0.0021	0.0005***
Controls								
Age 75–79	0.0613	0.0045	0.0522	0.0022	0.0467	0.0022	0.0524	0.0022
Age 80–84	0.1542	0.0066	0.1426	0.0031	0.1296	0.0031	0.1429	0.0031
Age 85+	0.3005	0.0085	0.2963	0.0042	0.2724	0.0042	0.2971	0.0042
Female	0.0752	0.0021	0.0819	0.0039	0.0499	0.0021	0.0753	0.0021
Any Proxy	0.1046	0.0035	0.1050	0.0036	0.1168	0.0035	0.1039	0.0035
Any Proxy * Post-1996	–0.0621	0.0050	–0.0629	0.0051	–0.0467	0.0051	–0.0614	0.0050
DK Proxy	0.0424	0.0146	0.0426	0.0146	0.0363	0.0146	0.0411	0.0148
DK Proxy * Post-1996	–0.0143	0.0479	–0.0142	0.0479	0.0135	0.0469	–0.0142	0.0479
Main effects								
Married					–0.0506	0.0045		
Northeast region							0.0006	0.0091
Midwest region							0.0019	0.0086
Southern region							0.0478	0.0089

Notes: DK = Do not know; N = 172,227. Sample is all persons aged seventy (seventy-one in 1982) and older in the NHIS. To account for the complex nature of sample design, variance estimation was conducted using SUDAAN software. The reference groups are: seventy to seventy-four, female, married, South. *, **, *** indicate a statistical significant trend relative to the trend for the reference group at the 0.10, 0.05, and 0.01 level, respectively.

Table 3A.2 Weighted descriptive statistics: 1982 to 2002

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Disabled	0.227	0.218	0.209	0.204	0.189	0.195	0.198	0.195	0.191	0.201	0.206	0.202	0.195	0.185	0.193	0.170	0.170	0.158	0.163	0.159	0.155
Years of education																					
0–8	0.464	0.416	0.398	0.396	0.373	0.346	0.334	0.325	0.308	0.297	0.276	0.269	0.252	0.246	0.220	0.213	0.202	0.191	0.186	0.181	0.171
9–11	0.155	0.163	0.169	0.164	0.157	0.163	0.164	0.163	0.165	0.148	0.164	0.152	0.159	0.152	0.158	0.171	0.162	0.153	0.148	0.152	0.135
12	0.210	0.239	0.256	0.253	0.264	0.283	0.287	0.297	0.306	0.315	0.326	0.331	0.335	0.344	0.353	0.322	0.330	0.329	0.346	0.332	0.343
13–15	0.083	0.087	0.091	0.100	0.107	0.106	0.110	0.109	0.114	0.123	0.120	0.124	0.135	0.131	0.130	0.166	0.175	0.180	0.183	0.184	0.193
16+	0.087	0.095	0.087	0.087	0.100	0.101	0.104	0.105	0.106	0.117	0.114	0.125	0.120	0.126	0.139	0.128	0.132	0.146	0.138	0.152	0.158
Non-Hispanic white	0.885	0.875	0.878	0.882	0.870	0.878	0.881	0.879	0.875	0.863	0.886	0.863	0.858	0.860	0.865	0.859	0.850	0.850	0.847	0.841	0.839
Age																					
70–74	0.359	0.416	0.415	0.417	0.416	0.411	0.411	0.410	0.407	0.414	0.407	0.405	0.401	0.400	0.394	0.380	0.368	0.373	0.371	0.356	0.357
75–79	0.322	0.295	0.306	0.293	0.297	0.297	0.298	0.299	0.291	0.285	0.280	0.288	0.287	0.286	0.298	0.299	0.301	0.305	0.303	0.305	0.302
80–84	0.197	0.177	0.170	0.179	0.176	0.175	0.176	0.177	0.184	0.182	0.186	0.185	0.188	0.184	0.179	0.191	0.196	0.185	0.197	0.203	0.200
85+	0.122	0.112	0.109	0.112	0.111	0.118	0.115	0.114	0.118	0.119	0.126	0.123	0.123	0.130	0.129	0.130	0.135	0.138	0.129	0.137	0.141
Female	0.615	0.607	0.613	0.608	0.605	0.607	0.605	0.607	0.602	0.597	0.598	0.595	0.598	0.602	0.595	0.594	0.594	0.590	0.591	0.587	0.590
Married	0.471	0.482	0.483	0.481	0.495	0.499	0.504	0.502	0.511	0.513	0.512	0.509	0.509	0.511	0.517	0.498	0.517	0.507	0.512	0.501	0.523
Region																					
South	0.325	0.323	0.334	0.345	0.336	0.335	0.344	0.335	0.343	0.340	0.343	0.341	0.329	0.344	0.336	0.347	0.343	0.343	0.341	0.345	0.358
West	0.174	0.184	0.183	0.162	0.163	0.176	0.178	0.184	0.180	0.191	0.186	0.194	0.193	0.188	0.205	0.185	0.200	0.189	0.194	0.194	0.195
Midwest	0.262	0.254	0.255	0.253	0.259	0.246	0.248	0.241	0.254	0.245	0.249	0.246	0.250	0.252	0.235	0.247	0.238	0.251	0.243	0.242	0.242
Northeast	0.240	0.240	0.228	0.239	0.242	0.242	0.229	0.240	0.223	0.225	0.223	0.219	0.228	0.216	0.224	0.220	0.218	0.217	0.221	0.219	0.205
Proxy																					
Any proxy	0.197	0.206	0.203	0.194	0.191	0.195	0.202	0.203	0.198	0.215	0.204	0.213	0.207	0.207	0.213	0.330	0.342	0.337	0.333	0.334	0.348
DK if proxy	0.004	0.004	0.008	0.006	0.008	0.012	0.013	0.008	0.008	0.012	0.011	0.008	0.012	0.012	0.009	0.001	0.004	0.001	0.001	0.000	0.001
Any proxy * post-1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.330	0.342	0.337	0.333	0.334	0.348
DK proxy * post-1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.001	0.001	0.000	0.001
Number of observations	6724	7650	7793	7035	4749	9522	9917	9457	9693	10175	10082	9038	10025	8168	4921	8239	7920	7799	7983	7757	7580

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