

Disability Trends Among Elderly Persons and Implications for the Future

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Objectives. This article used a new data source to examine the issue of disability trends among elderly persons and examined the potential implications of these trends on future health and long-term care needs.

Methods. We used the 1992–1996 Medicare Current Beneficiary Survey to examine time trends in rates of activities of daily living and instrumental activities of daily living disability and physical limitation among Medicare beneficiaries aged 65 and over. We used multinomial logit and least squares regression techniques to produce trend estimates that held the age, sex, race, and educational distributions constant and projected these trends into the future. Finally, we estimated the potential impact of disability decline on per capita Medicare spending on elderly persons.

Results. We found that disability among elderly persons is declining and that the trend toward a more educated elderly cohort explains some, but not all, of this decline. In the absence of downward disability trends, per capita Medicare expenditures would have grown even faster than they have.

Discussion. Although the decline in disability prevalence in recent years appears real, whether it continues has enormous implications for the size of the disabled population in the future and for the ability of the society to care for its disabled elderly members.

UNDERSTANDING trends in health and disability in older adult populations is crucial for public policy debates on pensions, retirement, and future health care spending. Considerable research has been done to gain such understanding. Some reports of trends in health and disability status have generated alarm about the possibility of rising disability rates, and other reports have produced relief from the prospect of falling rates. It is possible that both increasing and decreasing disability prevalence can be observed in the same population if trends are measured at different periods of time. However, attempts to reconcile these disparate observations raise important methodological questions about measurement of health and disability status over time.

Much of the industrialized world has experienced declines in age-specific mortality rates at older ages (e.g., Manton & Vaupel, 1995). However, the relationship between declining mortality and the health and functioning of the surviving population is ambiguous (Feldman, 1983; Manton, 1982; Shepard & Zeckhauser, 1980). Although prolonged life spans generally imply improvements in health at younger ages (Fries, 1980), longer lived survivors may tend to be frail if the onset of illness and disability is not also deferred. During the 1970s, National Health Interview Survey (NHIS) data showed increasing proportions of older Americans classifying themselves as limited in their capacity to perform normal activities (Baily, 1987; Colvez & Blanchet, 1981; Verbrugge, 1984; Verbrugge, Lepkowski, & Imanaka, 1989) and as suffering from a number of potentially disabling chronic conditions (Chirikos, 1986; Colvez & Blanchet, 1981; Verbrugge, 1984). Citing a number of methodological and conceptual problems in those surveys, National Center for Health Statistics (NCHS)

researchers warned against taking these trends at face value (Wilson & Drury, 1984). Even so, various social scientists have interpreted those data to imply that health deteriorated in the 1970s (Chirikos, 1986; Colvez & Blanchet, 1981; Crimmins, 1990; Crimmins & Ingegneri, 1993, 1995; Crimmins, Saito, & Reynolds, 1997; Verbrugge, 1984; Verbrugge et al., 1989). Those findings, combined with the fact that much of the mortality decline was attributable to lower death rates from chronic diseases (especially heart disease and stroke), made the view popular in some groups that increased longevity had led to increased frailty in the surviving elderly population (Gruenberg, 1977; McKinlay & McKinlay, 1977; Olshansky & Ault, 1986).

During the 1980s, however, the NHIS trend in self-reported disability prevalence changed dramatically, leveling off and perhaps even declining (Waidmann, Bound, & Schoenbaum, 1995). Data from a related survey, the Longitudinal Study of Aging, also showed modest improvements in certain measures (Crimmins et al., 1997). Other data pointed more strongly toward improvements in health and disability during the 1980s and 1990s. Most notably, findings from the National Long Term Care Survey suggested dramatic declines (of 15%) in age-adjusted disability and institutionalization prevalence for the U.S. population over age 65 from 1982 to 1994 (Manton, Corder, & Stallard, 1997; Manton, Stallard, & Corder, 1998).

Further evidence of improving health has come from a recent study using the Survey of Income and Program Participation, which found declines between 1984 and 1993 in limitations of physical functioning (Freedman & Martin, 1998). These measures of limitation in a variety of physical or sensory functions—reading a newspaper, lifting and car-

rying a package weighing 10 pounds, climbing a flight of stairs, walking three blocks—are thought to be less susceptible to environmental and sociocultural influences and more closely related to the physical component of disability than activities of daily living (ADL) and instrumental activities of daily living (IADL) measures (Nagi, 1965; Pope & Tarlov, 1991).

Understanding the implications of these findings is important for health and retirement policy, especially in the face of the impending retirement of the baby-boom generation. Kunkel and Applebaum (1992) calculated projections of the disabled population through 2040 under four simple sets of assumptions about future longevity and disability that are broadly consistent with research articles they reviewed from the 1980s. However, more recent research from the National Long Term Care Survey (Manton et al., 1997, 1998), as well as more recent findings from the NHIS (Waidmann et al., 1995), have called into question much of what was thought about disability trends at the end of the 1980s.

This study complements the existing literature on disability trends by adding findings from another data source representative of the entire elderly population, the Medicare Current Beneficiary Survey (MCBS). Using the detailed data available from this survey, we constructed a categorization of limitation and disability that is consistent with a formal model of disability (e.g., Pope & Tarlov, 1991). This allowed us to synthesize prior findings on trends in physical capacity, IADL and ADL disability, and institutionalization. In addition to measuring the rate of change in disability prevalence, we also examined the contributions of compositional changes in the population to the measured trend. To the extent that future compositional changes in the population can be anticipated, these findings can aid in projecting future trends in disability prevalence. We incorporated our data analysis into a projection model of future disability that allowed us to examine the contribution of both trends and compositional changes on the size of the disabled population.

To contribute to policy discussions on the future of the public sector health and long-term care programs, we used these projections to calculate the numbers of disabled elderly persons relative to the number of working-aged persons who will provide the bulk of the revenue for these programs. In addition, this study used linked Medicare administrative data to examine the relationship between disability trends and Medicare spending. Actuarial projections about the future of Medicare have not incorporated the prospect of declining disability (Board of Trustees, Federal Hospital Insurance Trust Fund, 1998). One highly visible discussion of implications of disability trends for Medicare (Manton et al., 1997) hypothesized a strong relationship between disability and Medicare spending but did not test that hypothesis with data. This article includes such an analysis.

DATA AND METHODS

We used the Access to Care files from the 1992–1996 waves of the MCBS in these analyses. The MCBS is a continuous, multipurpose survey of a representative sample of the Medicare population, including elderly and disabled persons living in the community and in institutions. The

MCBS is a multistage probability sample drawn from 107 primary sampling units representing the 50 states, the District of Columbia, and Puerto Rico. Respondents were sampled from the Medicare enrollment file to be representative of the entire beneficiary population and the populations in each of seven age groups. Those under 65 (disabled workers) and over 85 were oversampled because of interest in the special health care needs of those beneficiaries. Each annual sample contained approximately 12,000 beneficiaries, of whom 10,000 were elderly (65+). The first round of MCBS interviews was conducted in 1991 to obtain baseline information on the initial sample. It is a rotating longitudinal panel survey that is replenished annually to account for attrition (deaths, disenrollment, refusal, etc.), so that each year's data file, when weighted, contains a representative cross-section of Medicare beneficiaries. By design, respondents who entered the sample in 1991, 1992, and 1993 were phased out of the sample after no more than 6 years, and those who entered the sample in 1994 and beyond were followed for 4 years only. Respondents are interviewed three times per year whether they reside in the community or in a long-term care facility, using a questionnaire appropriate for the setting. In this study, however, we used only survey data collected in the fall round of interviews (September through December). MCBS survey data have been augmented with person-level administrative data (on reimbursements, program enrollment, etc.) from the Health Care Financing Administration (HCFA). More detailed information on the MCBS can be found elsewhere (Adler, 1994).

The MCBS collects a broad range of information, including payments for health care from all sources, demographic characteristics (e.g., age, sex, and education), and health and disability status indicators. Several measures of disability are available from the survey. For the purpose of the multivariate models in this study, we modeled disability as a hierarchical variable with five levels. A person was classified as nondisabled, physically limited, IADL disabled, ADL disabled, or institutionalized disabled. *Physical limitation* was defined as having difficulty with any of the five physical functions (stooping/kneeling, lifting 10 pounds, reaching over head, writing, walking two to three blocks) but not otherwise disabled. *IADL disability* was defined as having difficulty because of a health or a physical problem and receiving help with any of six IADL: using the telephone, doing light housework, doing heavy housework, preparing meals, shopping for personal items, and managing money. *ADL disability* was defined as having any difficulty and requiring help with any of the ADL: walking across a room, eating, dressing, bathing, transfer (getting in/out of chairs), and toileting. For the purposes of this study, *requiring help* included receiving the help of another person, having another person nearby in case help is needed, or using special equipment. *Institutionalized disabled* referred to those with IADL or ADL disabilities who resided in a long-term care facility at the time of the interview. This characterization is consistent with a model of disablement in which physical limitations precede the onset of functional disabilities, which appear first in IADL and then in ADL. Institutionalization is necessary when the severity of disability is the greatest.

Most disability models hypothesize that disease precedes and causes physical limitation. Unfortunately, the measurement of trends in disease prevalence with self-reported data is problematic. Changes in the practice of medicine and growing awareness of health issues have led to earlier diagnosis of chronic diseases (Waidmann et al., 1995). As most surveys (including the MCBS) ask whether respondents have been told by a doctor that they suffer from a particular chronic disease, changes in diagnosis rates make responses to these questions at different points in time incomparable. Thus, in our model we began with physical limitation rather than the presence of disease.

We modeled disability status (D) using a multinomial logit specification:

$$P(D_i = k) = \frac{\exp(\alpha_k + \mathbf{X}_i' \beta_k + \theta_k t)}{1 + \exp\left(\sum_{j=1}^4 \alpha_j + \mathbf{X}_i' \beta_j + \theta_j t\right)} \text{ for } k = 1, 2, 3, 4$$

$$P(D_i = 0) = \frac{1}{1 + \exp\left(\sum_{j=1}^4 \alpha_j + \mathbf{X}_i' \beta_j + \theta_j t\right)}, \quad (1)$$

where $\mathbf{X}$ is a vector of covariates, t is a time trend term (year – 1992); k indexes the four disabled states; and $D_i = 0$ for the nondisabled respondents. Thus, the log-odds of each disability state relative to the nondisabled state was modeled as a linear function of time and other covariates. A significant estimate of the θ terms indicated a finding of a trend in disability. The other factors that made up $\mathbf{X}$ include age (dummy variables each year of age from 66 to 89 and one for ages 90 and above), sex (dummy for male), race/ethnicity (Hispanic, non-Hispanic Black, non-Hispanic White [excluded], non-Hispanic Asian/Pacific Islander, and non-Hispanic American Indian/Aleut/Eskimo), years of education (≤ 8 years, 9–11 years, 12 years [excluded], 13–15 years, and ≥ 16 years), and marital status (single, married [excluded], and widowed). Including variables in the $\mathbf{X}$ vector served to standardize our estimate of the trends in disability prevalence by removing from the trend estimates the effects of changing population characteristics. Thus, if $\mathbf{X}$ included only age variables, the estimated trend was an age-standardized estimate. We present a series of trend estimates that standardize on different combinations of characteristics.

We then used the coefficient estimates from several specifications of the multinomial logit model to forecast the prevalence of various levels of disability into the future. Among the characteristics that have been projected to change most dramatically for the elderly population are age, race/ethnicity, and educational attainment. Thus, when we make projections of disability status in the future, we will use models that control for these factors. The U.S. Census Bureau has projected the population by age, sex, race, and Hispanic origin from 1995 to 2050 (Day, 1996). We used the middle series projections, based on a moderate set of assumptions regarding birth, death, and net immigration rates. For each age/sex/race/year cell, we calculated the probability of each disability state by using the estimated coefficients

from the model above. For forecasts that include education effects, we constructed projections by age, sex, and education, using the distribution of educational attainment from the 1995 Current Population Survey and sex-specific life tables estimated by the actuaries of the Social Security Administration. We assumed that there was no education differential in mortality, which was presumably inaccurate but which we expected to bias findings toward smaller declines (or larger increases) in disability. Forecasts of disability are presented through 2040, using results of several specifications of the multinomial logit model. For each forecast model, we present the size of the population in each disability state, thus incorporating the dramatic changes in the age structure that are projected in the first half of this century. Using these projections, we then calculated the projected ratio of working-aged adults to disabled elderly persons as one indicator of the potential financial stability of programs that will care for disabled persons in the future.

To examine the relationship between disability trends and Medicare expenditures, we used the 1992 and 1996 rounds of the data and used least squares to estimate the parameters of $R_{it} = \alpha_t + \mathbf{X}_{it}' \beta + \mathbf{D}_{it}' \gamma + \epsilon_{it}$, $t = 1992, 1996$, where R_{it} is the level of reimbursement for Medicare-covered services used by person i in year t , and $\mathbf{D}$ is a vector of indicators of the four disabled states. In addition to all the covariates from the multinomial logit models, the vector $\mathbf{X}$ used in this model also included a set of chronic condition indicators derived from survey self-reports. Using the estimated parameters from the reimbursement model, we then decomposed the change in the mean of R between 1992 and 1996 as

$$\begin{aligned} \overline{R}_{96} - \overline{R}_{92} &= (\hat{\alpha}_{96} - \hat{\alpha}_{92}) \\ &\quad + (\overline{\mathbf{X}}_{96} - \overline{\mathbf{X}}_{92})' \hat{\beta} \\ &\quad + (\overline{\mathbf{D}}_{96} - \overline{\mathbf{D}}_{92})' \hat{\gamma}. \end{aligned} \quad (2)$$

The first term captured the unexplained change in per capita reimbursement between 1992 and 1996. The second term (which we further decomposed into components attributable to sets of independent variables) gave the portion of the change attributable to changes in the vector of covariates. The last term captured the effect of shifts in the distribution of disability on per capita reimbursement. It is this effect that is of the most interest.

Although the MCBS allows for it, our treatment of the data did not use the longitudinal nature of the data. Rather than estimating changes in disability prevalence from variation within an individual, we identified trends in prevalence from variation between different individuals with the same characteristics across years. Thus, it is the trend in disability status across successive cohorts that we measured. We would have liked to have treated the 5 years of data as independent samples of the elderly population. However, because the pooled sample of 1992–1996 data contained repeated observations from the same individuals, there was less independent variation from year to year than the pooled sample size would indicate. Statistically, we modeled this as a correlation within the observations of each individual. Without adjusting for this correlation (i.e., assuming that repeated observations on the same individual were independent

dent), our estimated standard errors would have overstated the precision of our estimates. The adjusted standard errors we present were calculated by Stata (Stata Corporation, 1999), using an asymptotic bootstrap formula attributable to Huber (1967). The effect of the adjustment was to inflate the standard errors on the coefficients for variables that were most highly correlated within an individual (e.g., race, education). Conversely, the effect of this adjustment on the precision of the trend estimate was negligible. Finally, because of the rotating panel design, there were very few individuals with observations in both the 1992 and 1996 samples. Thus, the adjustments for the standard errors in the Medicare reimbursement model were also very small.

RESULTS

Table 1 presents the (weighted) mean distribution across the five disability states by year, age, sex, race, and education. The proportion of the population with no limitation or disability increased over time, but so did the proportion with physical limitation but no disability. The proportion with

IADL disabilities declined consistently, but the decline in ADL disability was concentrated largely in the last year. Finally, there was no discernible change in the proportion of the population characterized as institutionalized disabled. As suggested above, however, compositional shifts in the population may have confounded the simple trend estimates. Table 1 also indicates that the relationships between disability and age, sex, race, and education are strong. Disability prevalence increased with age; men had lower disability rates than women; African Americans, Hispanics, and Native Americans had higher rates than Whites, whereas Asian Americans had lower rates; and disability rates fell with educational attainment. Changes in the distributions of these characteristics over time can affect the population's disability prevalence.

Trends in Disability Rates

Table 2 presents the estimated trends in the disability status of the elderly population after controlling for different sets of characteristics in the multinomial logit model (Equation 1). We present the marginal effect of 1 year elapsing on

Table 1. Disability Status of Elderly Medicare Beneficiaries by Year, Sex, Age, Education, Race, and Marital Status, 1992–1996
Medicare Current Beneficiary Survey

	% of sample	% In each disability classification				
		Not disabled	Physically limited	IADL disabled	ADL disabled	Institutionalized disabled
Full sample	100.00	41.40	24.23	12.83	17.70	3.84
By year						
1992	19.89	41.23	23.47	13.66	18.02	3.62
1993	19.76	41.67	23.73	12.83	17.65	4.13
1994	19.89	40.84	23.87	13.32	18.04	3.93
1995	20.13	41.07	24.87	12.30	17.84	3.92
1996	20.33	42.20	25.19	12.04	16.96	3.61
By sex						
Female	59.14	35.72	24.02	15.13	20.24	4.88
Male	40.86	49.63	24.53	9.49	14.02	2.33
By age						
65–69	26.64	53.04	25.35	10.95	9.87	0.79
70–74	27.61	48.76	25.98	11.69	12.53	1.05
75–79	20.98	39.37	26.71	13.97	17.57	2.38
80–84	13.86	28.74	22.92	15.28	26.75	6.31
85–89	7.25	17.74	16.60	15.94	35.80	13.92
90+	3.66	7.69	8.80	13.04	44.31	26.16
By education						
8 or fewer years	24.96	29.86	23.32	15.58	25.51	5.72
9–11 years	15.76	36.88	25.96	13.30	20.14	3.72
High school graduate	31.93	44.22	25.95	12.14	14.04	3.64
Some college	13.96	47.14	23.45	11.72	15.51	2.18
College graduate	13.40	55.53	20.58	9.91	11.29	2.69
By race/ethnicity						
White	85.54	42.11	24.40	12.45	16.96	4.08
Black	7.65	34.75	22.85	14.09	25.17	3.14
Hispanic	5.12	39.52	24.49	16.33	18.33	1.33
Asian	1.12	48.82	17.90	17.22	14.19	1.86
Native American	0.57	27.21	26.72	12.33	30.13	3.61
By marital status						
Married	56.23	47.81	24.82	12.33	13.68	1.36
Widowed	32.45	30.89	22.96	14.16	24.61	7.39
Single	11.32	39.74	24.96	11.48	17.86	5.97

Notes: Tabulations based on 1992–1996 Medicare Current Beneficiary Surveys Access to Care files. $N = 60,311$. ADL = activities of daily living; IADL = instrumental activities of daily living.

the percentages in each category. The marginal effects were calculated by using the formula

$$\frac{\partial P_k}{\partial t} = P_k[\hat{\theta}_k - \bar{\theta}],$$

and significance levels were calculated by using the delta method (Greene, 1997).

The trends in disability status estimated without any covariates are presented in the first row of the table. Over the 4 years included in our data, there was a statistically significant increase in the probability of being physically limited but not disabled (0.46% per year) and a significant decrease in the probability of having only IADL disabilities (−0.38% per year). However, there were no significant changes in the probability of being more severely disabled (i.e., ADL or institutionalized). The probability of having no limitation or disability increased by 0.14% per year.

After standardizing on age and sex, however, all estimated trends in probabilities were statistically significant (full results are available from us). The magnitude of the trend in the probability of being limited but not disabled increased slightly (to 0.52%). Similarly, the estimate on IADL disability was slightly stronger (−0.41%). More striking was the increase in the estimate for ADL disability to −0.41% per year. This implies that age- and sex-specific prevalence rates of ADL disability fell, but that population aging largely offset those declines. Similarly, there was a statistically significant decrease in the age- and sex-specific prevalence of institutionalized disability of 0.08% per year on average. Consequently, the age- and sex-adjusted probability of having any limitation or disability fell by 0.38% per year.

Adjusting for changes in the racial composition of the elderly population had no substantive or statistical effect on the trend estimates, but if we further adjusted for shifts in educational attainment, the estimated trend in ADL disability weakened. The −0.28% annual change was still significant, but this finding suggests that increased education is behind some of the previously estimated trends in ADL disability. Adjusting for marital status changes had no effect on trend estimates.

Finally, we also included several sets of interaction terms (Trend × X) to test whether subgroups of the population experienced different trends in disability status, but we were unable to reject the hypothesis that the groups (race, education, marital status, age, or sex) had the same trends.

Projections of Future Disability Prevalence

Our forecasts of future disability status depend on both the trend estimates presented above and the projections of compositional changes in the elderly population. Table 3 presents means of the independent variables incorporated in the disability forecasts for three periods: 2000, 2020, and 2040. The composition of the elderly population is projected to change dramatically in the next 40 years (Day, 1996). One such change is an increase in the proportion of the population that will be of Hispanic or Asian origin. The proportion who are African American will rise slightly, and the fraction classified as White will fall from its current (2000) level of 83.9% to 70.3% in 2040.

We predict similarly dramatic changes in education, although most of those changes will take place by 2020. Our simple projections based on the age, sex, and education distribution of the 1995 Current Population Survey and Census Bureau life tables for 1995 suggest an increase in the average educational attainment of the elderly population. On the base of our projections, in the year 2000, approximately 31% of elderly persons have less than a high school education, and 14% have a bachelor's degree. In 2020, fewer than 15% will have less than a high school education, and more than 25% will have a bachelor's degree. By 2040, 11.5% will have less than a high school education, but the proportion with a college degree will remain constant at 25.4%.

These projections may underestimate educational attainment because we assume no differential mortality by education. If—as has been shown (Preston & Taubman, 1994; Rogot, Sorlie, & Johnson, 1992)—the more educated have lower age-specific death rates, then we would expect that the fraction with low educational attainment will be lower and the fraction with high educational attainment will be higher. On the other hand, these projections also assume

Table 2. Estimated Annual Percentage Point Changes in Disability Status Based on Multinomial Logistic Regression

Status	(1)	(2)	(3)	(4)	(5)
Not disabled	0.14	0.38	0.39	0.16	0.15
Physically limited	0.46*	0.52*	0.52*	0.55*	0.55*
IADL disabled	−0.38*	−0.41*	−0.43*	−0.37*	−0.38*
ADL disabled	−0.19	−0.41*	−0.41*	−0.28*	−0.27*
Institutional disabled	−0.02	−0.08*	−0.08*	−0.06**	−0.05**
Controlling for					
Age & sex		x	x	x	x
Race			x	x	x
Education				x	x
Marital status					x
Total N	60,311	60,311	60,311	60,311	60,311
Likelihood ratio χ^2 (df)	19.8 (4)	4,073.3 (108)	4,218.3 (124)	4,595.1 (140)	4,781.8 (148)
p	.0005	<.0001	<.0001	<.0001	<.0001

Notes: Estimates based on 1992–1996 Medicare Current Beneficiary Survey Access to Care files. ADL = activities of daily living; IADL = instrumental activities of daily living.

* $p < .05$; ** $p < .10$.

Table 3. Means of Independent Variables Used in Forecasts

Variable	2000	2020	2040
Age			
65–69	0.271	0.329	0.223
70–74	0.251	0.260	0.216
74–79	0.214	0.177	0.213
80–84	0.141	0.112	0.168
85–89	0.077	0.066	0.102
90+	0.046	0.056	0.079
Sex			
Female	0.587	0.553	0.543
Male	0.413	0.447	0.458
Race/ethnicity			
White	0.839	0.779	0.703
Black	0.080	0.087	0.093
Hispanic	0.054	0.089	0.144
Asian	0.023	0.040	0.054
Native American	0.004	0.005	0.005
Education			
≤8 years	0.179	0.066	0.041
9–11 years	0.134	0.079	0.075
12 years	0.366	0.346	0.346
13–15 years	0.179	0.255	0.285
16+ years	0.143	0.254	0.254

Note: Tabulations based on 1991–1996 Medicare Current Beneficiary Survey Access to Care files, U.S. Census Bureau projections and life tables, and 1995 CPS, March file.

that any new immigrants will have the same educational attainment as those currently residing in the United States. To the extent that new immigrants have lower levels of education, our estimates may be biased upward.

Mostly a reflection of the size of the baby-boom cohorts, the average age of the elderly population will decline slightly between 1995 and 2020 when these cohorts are younger than 75. By 2040, when the survivors of this generation are past age 75, the average age of the elderly population will increase.

Figures 1–6 present projections of the elderly population by (cumulative) disability status through the year 2040 under several scenarios. It is quite apparent that the forecast of future disability rates is quite sensitive to the model used to estimate prevalence. Figure 1 assumes that current prevalence rates for our five disability/limitation states remain constant and applies those rates to the projected elderly population through 2040. If this assumption holds, of the approximately 75 million elderly persons in 2040, 44 million will have at least some physical limitation. Of those with physical limitation, 26 million will also have at least one IADL disability, 16 million will have at least an ADL disability, and 3 million will be institutionalized. The fastest growth in these numbers will occur between 2010 and 2030 when the baby-boom cohorts first enter the elderly ages, and the growth will begin to slow after 2030.

In Figure 2, we assume that the changes in disability prevalence (i.e., the estimated trends in relative odds) that we observed between 1992 and 1996 continue indefinitely. Under this scenario, although the number with physical limitations is approximately the same, the downward trends we estimate for IADL and ADL disabilities are large enough to offset the tremendous growth in the elderly population. The

number of IADL disabled elderly persons remains roughly constant at 10 million, and the number of ADL disabled remains around 8 million.

In Figures 3 and 4, we assume that subgroup prevalence rates remain constant, but we incorporate compositional shifts in the population that are projected to occur. In Figure 3, we incorporate predicted changes in age, sex, and race, whereas in Figure 4, we incorporate changes in age, sex, and educational attainment. What is striking about these figures is their similarity to each other and to Figure 1. Regardless of the assumption made, the choice of compositional factors to include in projections makes little difference. Recall that in Table 2, we found that accounting for trends in educational attainment between 1992 and 1996 substantially contributed to disability trends, and changes in racial composition had no effect on trend estimates. What these figures indicate is that the future increases in educational attainment may not have the same effect, and we may have achieved most of the gains that are to be had from increases. Although we were not able to expand the sets of factors included in these projections (e.g., to control for race and education and marital status), the similarities among Figures 1, 3, and 4 suggest that these additions would not produce substantially different findings.

Finally, when we incorporated both compositional shifts and trends in disability, our findings were similar to those when we included only a trend. If they continue, declines in IADL and ADL disability prevalence estimated in the MCBS will be large enough to offset future increases in the elderly population, such that elderly population growth will occur only in the two healthiest categories.

In Table 4, we use these projections and the Census Bureau population projections (Day, 1996) to estimate the ratio of working-aged persons per disabled elderly person at the endpoint of our projections. In 1995, there were approximately five working-aged adults for each elderly person in the United States. In 2040, that ratio is projected to decrease to 3:1. The first projection (a) in Table 4 assumes that there is change in neither the composition of the population nor the prevalence of disability among those over age 65. Under these naïve assumptions, the ratio of working-aged adults to elderly persons with at least IADL disability falls from 13:1 to 8:1, and the number supporting each ADL-disabled elderly person falls from 21 to 12. Of the five sets of alternative assumptions we use, those that do not allow for a trend (b, c) show roughly the same result as the naïve assumptions. However, if we assume that the trends in prevalence estimated for the period 1992–1996 continue (d–f), the number of working-aged adults supporting each disabled elderly person rises above its current level to between 19 and 36.

The Effect of Disability Trends on Medicare Payments

To illustrate the potential implications of disability rate changes on individual health care expenditures, we decomposed the change in average Medicare reimbursements between 1992 and 1996 and calculated the change due to changes in disability status (full results available from us). Table 5 indicates that average per capita reimbursements for Medicare Part A and Part B increased by \$889 (or by 30.7% over the 1992 average of \$2,896) over the 4-year period.

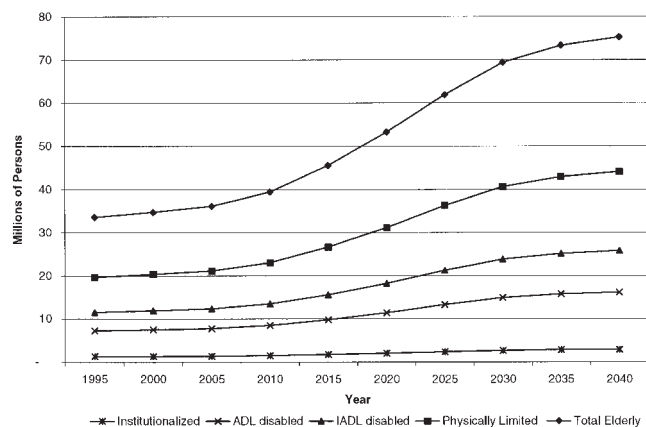


Figure 1. Projected number of elderly persons by disability status, 1995–2040: Naive projection. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

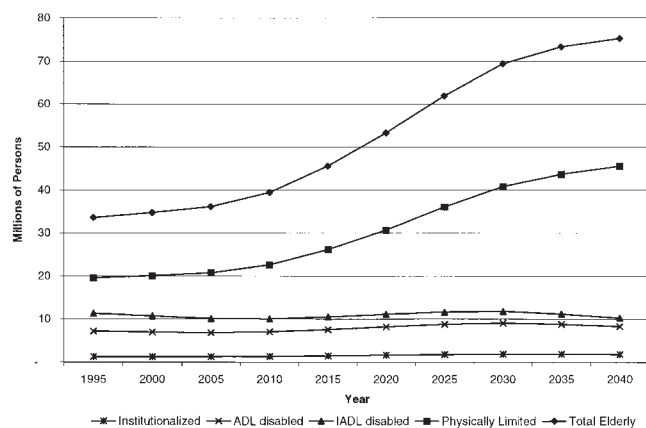


Figure 2. Projected number of elderly persons by disability status, 1995–2040: Incorporating trend only. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

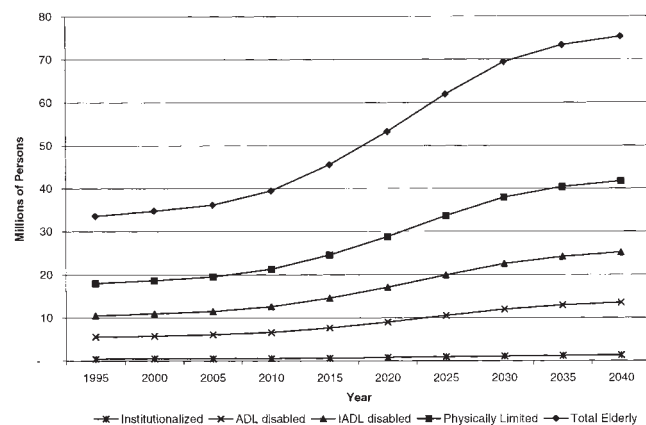


Figure 3. Projected number of elderly persons by disability status, 1995–2040: Incorporating age, sex, and race changes. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

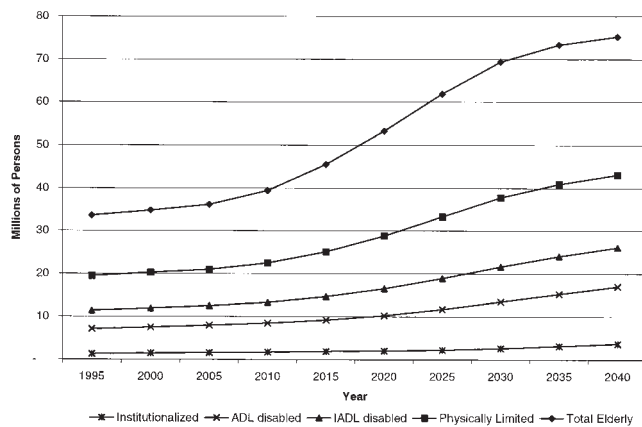


Figure 4. Projected number of elderly persons by disability status, 1995–2040: Incorporating age, sex, and education changes. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

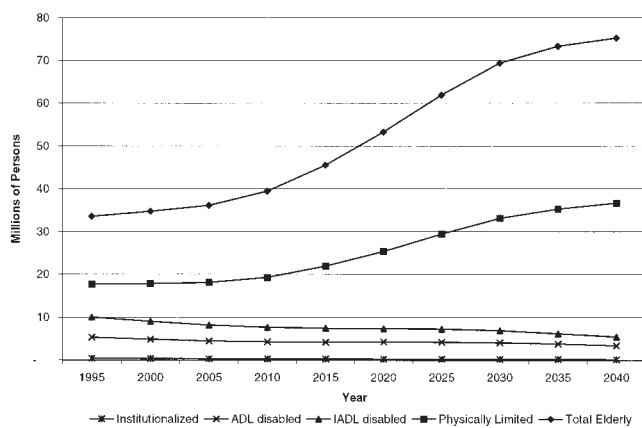


Figure 5. Projected number of elderly persons by disability status, 1995–2040: Incorporating age, sex, and race changes and trend. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

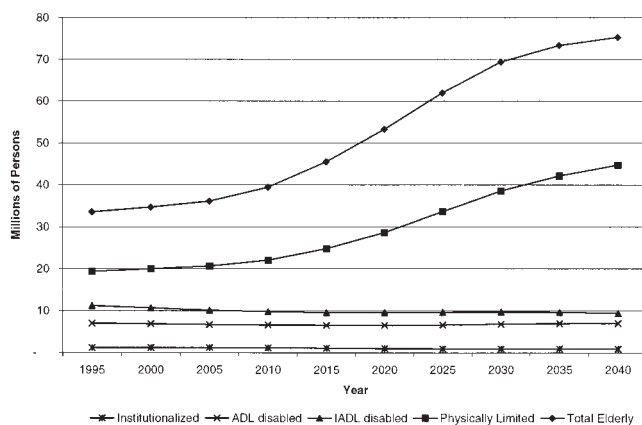


Figure 6. Projected number of elderly persons by disability status, 1995–2040: Incorporating age, sex, and education changes and trend. Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

Table 4. Number of Working-Aged Adults per Elderly Person, by Disability Level

Year/Projection	Total elderly	Physically limited or disabled	IADL disabled	ADL disabled	Institutionalized
1995	5	8	13	21	119
2040					
a. Naïve assumption (no change in composition or rates)	3	4	8	12	68
b. Projected race composition with no trend	3	5	8	14	149
c. Projected education composition with no trend	3	5	8	12	53
d. Simple trend	3	4	19	24	111
e. Trend controlling for race composition	3	5	36	57	869
f. Trend controlling for education composition	3	4	21	28	201

Notes: Simulations based on 1992–1996 Medicare Current Beneficiary Survey and Census Bureau population projections. ADL = activities of daily living; IADL = instrumental activities of daily living.

Had it not been for changes in demographic and disability variables, however, the average would have increased by nearly \$1,000. Controlling for demographic shifts, declines in disability saved the Medicare program \$97 per beneficiary (or 3.3%) in 1996 relative to 1992. The effect of demographic shifts on reimbursements is small relative to that of disability declines. Finally, we also ran a model including self-reports of chronic conditions, but the net effect of changes in these reports was less than \$1 over the 4-year period.

DISCUSSION

Our findings suggest that after controlling for changes in demographic composition, disability rates among elderly persons declined in the early 1990s. Consistent with other studies, the strongest declines were found in IADL disability, but statistically significant declines were also found in ADL disability as well as in institutional disability. However, the evidence also suggests that although elderly persons were better able to carry on the activities necessary for independent living, many still face physical limitations. In fact, a majority of the reduction in disability prevalence was accounted for by increases in the prevalence of nondisabling physical limitation. It is clear, though, that the increases in the prevalence of physical limitation represent improvements in overall health and functioning, as the proportion of elderly persons without any limitation is also increasing. Further, we find that these trends are large enough that if they continue, the ratio of working-aged adults to disabled elderly persons will not fall below current levels even after all baby-boom cohorts are 65 or older. If the current

trends do not continue, we project that this support ratio will fall substantially, even if one allows for projected increases in educational attainment that have been associated with improved health and functioning.

Although our finding of statistically significant declines in disability prevalence and overall improvement in functioning is consistent with recent findings from other data sources (Crimmins et al., 1997; Freedman & Martin, 1998, 1999; Manton et al., 1997), comparing levels of disability prevalence and the magnitudes of declines across studies is problematic. Wiener, Hanley, Clark, and Van Nostrand (1990) have provided a comparison of estimates obtained from differently designed survey instruments, but as a relatively new survey, the MCBS has not been subject to such comparisons.

Compared with findings from the National Long Term Care Survey (NLTCs) and the Longitudinal Study of Aging (LSOA), the levels of ADL and IADL disability are high in the MCBS. We estimate that in 1994 35.3% of the elderly respondents had at least IADL disability, whereas the 1994 NLTCs estimate is 21.3% (Manton et al., 1997). Several factors contribute to this finding. The NLTCs definition of disability requires that a person be unable to perform an activity without help because of a health problem that is expected to last at least 90 days. Using the MCBS, we were unable to replicate this definition, and three key differences in the definition all point toward larger prevalence estimates. First, the MCBS question asks about any difficulty with an activity rather than an inability to perform. Second, there is no requirement in the MCBS that the precipitating health problem be chronic. Third, the MCBS questionnaire does not ask about the need for help to perform an activity but rather about the presence of help, whether needed or not.

The 1990 LSOA estimate of disability prevalence among noninstitutionalized persons aged 76 and above was 20.5% (Crimmins et al., 1997). A similar restriction on the MCBS sample produced an estimate of 49.0%. The LSOA definition of disability is similar to that from the NLTCs, with the exception that disability is not required to be chronic. Thus, for the reasons discussed above we expected the MCBS estimate to be larger than the LSOA estimate.

It can be argued that differences in disability prevalence estimates that arise from differences in survey design capture different health concepts. Thus, even comparing trends in these measures is questionable. Certainly one should not

Table 5. Decomposition of Change in Per Capita Medicare Spending, 1992–1996

Component	Difference 1992–1996	% Change from 1992 average
Total	\$888.79	30.7
Year	997.51	34.4
Age	–17.34	–0.6
Sex	8.07	0.3
Education	3.84	0.1
Race	–2.68	–0.1
Marital status	–3.79	–0.1
Disability	–96.82	–3.3

Note: Calculations based on analysis of 1992 and 1996 Medicare Current Beneficiary Survey.

attempt to compare absolute changes in prevalence levels across surveys, but one should also exercise caution in interpreting relative changes. Nonetheless, in the context of other findings, our estimates of relative changes in disability are larger than others in the literature. Our estimates indicated a 1.8% relative decline per year in disability (IADL or greater) prevalence between 1992 and 1996. After standardizing on age and sex, this estimate increased to 2.3% per year. Using the NLTCs, Manton and colleagues (1997) estimated that the age-standardized prevalence of disability (including IADL, ADL, and institutionalization) declined by an average of 1.3% per year between 1982 and 1994, with some acceleration in the decline after 1989. Although Crimmins and colleagues (1997) found no consistent pattern from the LSOA between 1984 and 1990, after standardizing the NHIS on age and sex they found that the combined prevalence of routine needs and personal care disability—conceptually similar, respectively, to IADL and ADL disability—declined by 0.9% per year between 1982 and 1993 for persons aged 70 and older.

The greater decline in disability prevalence—as well as the higher prevalence rates—recorded in the MCBS, relative to the NLTCs and LSOA, may be a function of the relatively loose definition of disability used by the MCBS. We conjecture that individuals with relatively marginal degrees of disability (reflected in the MCBS prevalence rates but not in the rates of other surveys) are most likely to benefit from technological and environmental innovations in long-term care. Hence, the greater decline in prevalence rates may be due, at least in part, to higher proportions of marginally disabled persons becoming independent because of these innovations.

Our findings on the prevalence of physical limitation are not easily compared with those from the Survey of Income and Program Participation (SIPP). Freedman and Martin (1998) estimated the prevalence of four specific limitations (seeing a newspaper, lifting 10 pounds, climbing a flight of stairs, and walking a quarter mile), whereas we estimated the fraction of the elderly population that had difficulty with any one of five physical functions but who were not disabled in either ADL or IADL. In addition, the MCBS questionnaire asks, “How much difficulty, if any, do you have . . . ?” and gives respondents the options “no difficulty at all,” “a little difficulty,” “some difficulty,” “a lot of difficulty,” and “not able to do it,” whereas the SIPP asks, “Do you have any difficulty . . . ?” If we calculate the prevalence of the two individual limitation items common to the two surveys and define limitation as having at least some difficulty, MCBS estimates are very similar to SIPP estimates. Compared with Freedman and Martin’s findings on declines in individual physical limitations, our findings on a more global measure are smaller. Among the elderly persons in the SIPP, the prevalence of difficulty with four activities declined by between 1.0% per year (walking one-quarter mile) and 2.3% per year (seeing/reading). The prevalence of our measure (having at least one physical limitation or disability) declined by 0.5% per year. Finally, our finding that future increases in educational attainment may not be associated with further improvements in disability status is consistent with SIPP findings on individual functional limitation (Freedman & Martin, 1999).

Using evidence on the direction and rate of change in health among the elderly population is important in making good forecasts of future health changes. Predicting future trends in the health of the elderly population has important implications for policy and planning in a number of areas. Without changes in social security policy regarding the normal retirement age, increases in longevity would seem to imply greater costs in supporting the U.S. elderly population. However, if, as our findings suggest, longevity increases are accompanied by improvements in health, then it is possible that the expected working life span can also be extended (Tolley & Manton, 1996, 2000). This possibility has lent support to proposals to delay entitlement to Social Security benefits beyond the provisions in current law.

In addition to pressures on income support for the elderly population, demographic changes may also place major burdens on systems of health care and social support. The impact of changing prevalence rates of chronic disease and disability on health policy is even more direct than on retirement policy. However, much of the current Medicare debate has ignored the possibility of including the effects of positive changes in health in calculating the acute and long-term care needs of the future elderly population—or of developing public health and medical research strategies to promote such changes. Our findings suggest that even in the face of the dramatic growth in the elderly population, if disability prevalence rates continue their current decline, the number of disabled elderly persons will not grow either in absolute terms or relative to the size of the working-aged population. This finding is consistent with that of Singer and Manton (1998), who found that the support ratio for disabled persons through 2072 will remain higher than its current level as long as disability continues to decline by 1.5% per year.

However, even if the size of the chronically disabled population does not increase relative to the working-aged population, controlling the growth of per capita acute and long-term care costs is crucial to the continued health of the programs that finance these services. If per capita costs in Medicare and Medicaid continue to outpace real economic growth, these programs could still experience fiscal crisis in the future. For that reason, it is also important to understand the extent to which disability trends might affect per capita spending. Our findings suggest that accounting for possible declines in disability can have an impact on forecasts of per-capita spending for acute care services. However, it is clear that more research is necessary to fully understand these impacts. First, most of the concern about caring for disabled elderly people focuses not on the acute care services that Medicare covers, but rather on long-term care needs covered by Medicaid. Second, the analysis we present examines only net changes in acute care expenditures. The relationship between acute care utilization and disability may be a complex one. For example, an expectation of longer active life might increase the demand for elective procedures like cataract surgery and joint replacement. Moreover, the increased use of these procedures may be partly responsible for disability decline. In either case, decreased disability is associated with higher Medicare expenditures. Thus, a closer examination of the relationship between health care costs and disability decline is

necessary before we can believably forecast the future of Medicare.

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References

- Adler, G. S. (1994). A profile of the Medicare Current Beneficiary Survey. *Health Care Financing Review*, 15(4), 153–163.
- Baily, M. N. (1987). Aging and the ability to work: Policy issues and recent trends. In G. Burtless (Ed.), *Work, health and income among the elderly* (pp. 59–97). Washington, DC: Brookings Institution.
- Board of Trustees, Federal Hospital Insurance Trust Fund. (1998). *1998 Annual Report*. Washington, DC: U.S. Government Printing Office.
- Chirikos, T. N. (1986). Accounting for the historical rise in work-disability prevalence. *Milbank Quarterly*, 64, 271–301.
- Colvez, A., & Blanchet, M. (1981). Disability trends in the United States population 1966–76: Analysis of reported causes. *American Journal of Public Health*, 71(5), 464–471.
- Crimmins, E. M. (1990). Are Americans healthier as well as longer-lived? *Journal of Insurance Medicine*, 22, 89–92.
- Crimmins, E. M., & Ingegneri, D. G. (1993). Trends in health among the American population. In A. M. Rappaport & S. L. Schieber (Eds.), *Demography and retirement: The 21st century* (pp. 225–253). Westport, CT: Praeger.
- Crimmins, E. M., & Ingegneri, D. G. (1995). Trends in health of the U.S. population: 1957–1989. In J. Simon (Ed.), *The state of humanity* (pp. 72–83). Cambridge, MA: Blackwell.
- Crimmins, E. M., Saito, Y., & Reynolds, S. L. (1997). Further evidence on recent trends in the prevalence and incidence of disability among older Americans from two sources: The LSOA and the NHIS. *Journal of Gerontology: Social Sciences*, 52B, S59–S71.
- Day, J. C. (1996). *Population projections of the United States by age, sex, race and Hispanic origin: 1995–2050* (U.S. Bureau of the Census, Current Population Reports, P25-1130). Washington, DC: U.S. Government Printing Office.
- Feldman, J. J. (1983). Work ability of the aged under conditions of improving mortality. *Milbank Memorial Fund Quarterly*, 61, 430–444.
- Freedman, V. A., & Martin, L. G. (1998). Understanding trends in functional limitations among older Americans. *American Journal of Public Health*, 88(10), 1457–1462.
- Freedman, V. A., & Martin, L. G. (1999). The role of education in explaining and forecasting trends in functional limitations among older Americans. *Demography*, 36(4), 461–473.
- Fries, J. F. (1980). Aging, natural death, and the compression of morbidity. *New England Journal of Medicine*, 303, 130–135.
- Greene, W. H. (1997). *Econometric analysis*. New York: Macmillan.
- Gruenberg, R. M. (1977). The failure of success. *Milbank Memorial Fund Quarterly*, 55, 3–24.
- Huber, P. J. (1967). The behavior of maximum likelihood estimates under non-standard conditions. In *Proceedings of the Fifth Berkeley Symposium in Mathematical Statistics and Probability* (pp. 221–223). Berkeley: University of California Press.
- Kunkel, S. R., & Applebaum, R. A. (1992). Estimating the prevalence of long-term disability for an aging society. *Journal of Gerontology: Social Sciences*, 47, S253–S260.
- Manton, K. G. (1982). Changing concepts of morbidity and mortality in the elderly population. *Milbank Quarterly*, 60, 183–244.
- Manton, K. G., Corder, L., & Stallard, E. (1997). Chronic disability trends in the U.S. elderly populations 1982 to 1994. *Proceedings of the National Academy of Sciences*, 94, 2593–2598.
- Manton, K. G., Stallard, E., & Corder, L. S. (1998). The dynamics of dimensions of age related disability 1982 to 1994 in the U.S. elderly population. *Journal of Gerontology: Biological Sciences*, 53A, B59–B70.
- Manton, K. G., & Vaupel, J. W. (1995). Survival after the age of 80 in the United States, Sweden, France, England, and Japan. *New England Journal of Medicine*, 333(18), 1232–1235.
- McKinlay, J. B., & McKinlay, S. M. (1977). Questionable contribution of medical measures to the decline of mortality in the United States in the twentieth century. *Milbank Memorial Fund Quarterly*, 55, 405–428.
- Nagi, S. (1965). Some conceptual issues in disability and disability and rehabilitation. In M. B. Sussman (Ed.), *Sociology and rehabilitation* (pp. 100–113). Washington, DC: American Sociological Association.
- Olshansky, S. J., & Ault, A. B. (1986). The fourth stage of the epidemiologic transition: The age of delayed degenerative diseases. *Milbank Quarterly*, 64(3), 355–391.
- Pope, A. M., & Tarlov, A. (Eds.). (1991). *Disability in America: Toward a national agenda for prevention*. Washington, DC: National Academy Press.
- Preston, S. H., & Taubman, P. (1994). Socioeconomic differences in adult mortality and health status. In L. G. Martin & S. H. Preston (Eds.), *Demography of aging* (pp. 279–318). Washington, DC: National Academy Press.
- Rogot, E., Sorlie, P. D., & Johnson, N. J. (1992). Life expectancy by employment status, income, and education in the National Longitudinal Mortality Study. *Public Health Reports*, 107(4), 457–461.
- Shepard, D., & Zeckhauser, R. (1980). Long-term effects of interventions to improve survival in mixed populations. *Journal of Chronic Diseases*, 33, 413–433.
- Singer, B. H., & Manton, K. G. (1998). The effects of health changes on projections of health service needs for the elderly population of the United States. *Proceedings of the National Academy of Sciences*, 95, 15618–15622.
- Stata Corporation. (1999). *Stata statistical software: Release 6.0*. College Station, TX: Author.
- Tolley, H. D., & Manton, K. G. (1996). Disability adjusted cost savings for changes in normal retirement age. *Social Security Bulletin*, 59(4), 71–74.
- Tolley, H. D., & Manton, K. G. (2000). Mortality models with health state variables. Manuscript submitted for publication.
- Verbrugge, L. (1984). Longer life but worsening health? Trends in health and mortality of middle-aged and older persons. *Milbank Memorial Fund Quarterly*, 62, 475–519.
- Verbrugge, L., Lepkowski, J., & Imanaka, Y. (1989). Comorbidity and its impact on disability. *Milbank Quarterly*, 67, 450–484.
- Waidmann, T., Bound, J., & Schoenbaum, M. (1995). The illusion of failure: Trends in the self-reported health of the U.S. elderly. *Milbank Quarterly*, 73(2), 253–287.
- Wiener, J. M., Hanley, R. J., Clark, R., & Van Nostrand, J. F. (1990). Measuring the activities of daily living: Comparisons across national surveys. *Journal of Gerontology: Social Services*, 45, S229–S237.
- Wilson, R. W., & Drury, T. F. (1984). Interpreting trends in illness and disability: Health statistics and health status. In *Annual Review of Public Health* 5 (pp. 83–106). Palo Alto, CA: Annual Reviews.

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