Understanding Trends in Functional Limitations Among Older Americans

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ABSTRACT

Objectives. This report documents trends in functional limitations among older Americans from 1984 to 1993 and investigates reasons for such trends.

Methods. We applied logistic regression to data for noninstitutionalized Americans aged 50 years and older from the Survey of Income and Program Participation. We focused on 4 functional limitation measures unlikely to be affected by changes in role expectations and living environments: reported difficulty seeing words in a newspaper, lifting and carrying 10 pounds, climbing a flight of stairs, and walking a quarter of a mile.

Results. We found large declines in the crude prevalence of functional limitations, especially for those 80 years and older. Generally, changes in population composition explained only a small portion of the downward trends. Once changes in population composition and mobility-related device use were considered for difficulty walking, significant improvements in functioning remained for the 65- to 79-year-old group.

Conclusions. Changes in population composition, device use, survey design, role expectations, and living environments do not appear to account completely for improvements in functioning. We infer that changes in underlying physiological capability—whether real or perceived—likely underlie such trends. (*Am J Public Health.* 1998;88: 1457–1462)

A fundamental issue in aging research is whether decreases in mortality at older ages have been accompanied by changes in health.[1–3] As the number of older Americans grows at an unprecedented rate, there has been concern that the proportion who are disabled might be increasing. Evidence from the 1970s and early 1980s showed such a trend.[4–6] Analysis of more recent data by Manton and colleagues shows declines in disability at older ages,[7,8] whereas work by Crimmins and colleagues yields mixed results.[6,9]

At the heart of this debate are critical issues of measurement. Thus far, analyses of trends have been largely limited to individuals' self-assessments of their ability to carry out specific roles, most often measured by activities of daily living (ADLs), such as bathing and eating, and instrumental activities of daily living (IADLs), such as shopping and doing laundry. Such measures are, however, highly influenced by socially defined roles and the sociocultural and physical environment.[10–13] Thus, declines in the prevalence of activity limitations over time could be a reflection of changes in individuals' expectations about their ability to function independently or of environmental modifications, rather than improvements in underlying physiological capability.

A clearer understanding of the extent to which changes in disability reflect changes in the underlying physiological capability of older Americans may offer insight into future patterns of disability, thereby facilitating planning for medical and social services for the older population. Our goals are thus twofold: to examine recent trends in functional limitations among older Americans and to shed light on possible explanations for such changes. We focus on functional limitations—defined as difficulty with basic body functions such as seeing, lifting and carrying, climbing, and walking—rather than the more usual ADLs and IADLs, because they are less sensitive to expectations about roles and changes in the environment.[10–13] Further, unlike previous trend analyses, we explicitly factor out changes in the composition of the older population in a number of socioeconomic and demographic characteristics. In addition, for one functional limitation, we also factor out the effect of changes in the use of assistive devices. Thus, our analysis brings us closer to understanding the extent to which trends in functioning reflect changes in underlying physiological capability.

Methods

Data

We used data from the US Bureau of the Census's Survey of Income and Program Participation (SIPP), an ongoing longitudinal household survey designed to measure the economic situations of individuals and families.[14] Each year since 1984 a nationally representative sample of the household-based population (or "panel") has been randomly selected and followed for over 2 years, with in-person interviews once every 4 months. Four of the 9 panels for which data are available for public use—1984, 1990, 1991, and 1993—were administered a detailed topical module on health and disability at the third contact.[15,16] Sample weights allow construction of nationally representative, cross-sectional estimates of individual characteristics. Thus, the SIPP provides a time series of independent cross-sections of the older US

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This paper was accepted March 25, 1998.

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population that can be used to analyze functioning trends.

We focused on the 50-and-over population and stratified models by broad age groups (50–64, 65–79, and 80 and over). To facilitate comparison with previously published research, we also present results for the 65-and-older group. To simplify presentation, we include findings for only 1984 and 1993. Omitting the intervening years does not change our overall conclusions about trends, although we typically found significant changes for longer rather than shorter intervals. Our sample sizes were 13 277 in 1984 and 12 716 in 1993. Of the total sample (n = 25 993), 13 954 individuals were aged 50 to 64 years, 9570 were aged 65 to 79 years, and 2469 were aged 80 years or older.

We evaluated several potential threats to validity in our trend estimates that were related to survey administration and coverage—namely, loss to follow-up, imputation rates for functional limitation measures, proxy reporting, the relative size of the institutional population, and changes in question wording. In general, we found relatively small changes over time in survey administration. Cumulative attrition by the third wave was modest and increased only slightly, from 12.3% in 1984 to 16.2% in 1993. There are multiple reasons for attrition, and the SIPP sample weights that we used adjusted for loss to follow-up through the third wave. The proportion of imputed responses for functional limitation items was extremely low (less than 5% on average for all years) and increased by only 3 percentage points over the period. The level of proxy responses was essentially constant at 37%; the overwhelming majority of proxies were spouses answering for their husbands or wives. Although the SIPP data do not allow us to assess changes in the institutional population, other studies show that the proportion of the older population in institutions remained stable over the period.[7,17,18] Finally, the wording of questions about functional limitations remained essentially the same. Thus, on balance, we would expect minimal bias to result from changes in survey administration and coverage of the SIPP.

Measures

The SIPP health and disability module asked respondents whether they had any difficulty carrying out a variety of functions. Four of the functions were assessed consistently over time, in questions asking whether the respondent had any difficulty in

- Seeing the words and letters in ordinary newspaper print, even when wearing glasses or contact lenses if usually worn
- Lifting and carrying something as heavy as 10 lb, such as a full bag of groceries
- Climbing a flight of stairs without resting
- Walking a quarter of a mile (about 3 city blocks)

From this information, we created 4 separate outcomes, coded 1 if an individual reported difficulty and 0 otherwise.

One difference in questionnaire design worth noting is that in 1984, interviewers were instructed parenthetically before questions on difficulty lifting, climbing, and walking to ask any respondent who used special aids whether he or she experienced difficulty while using the aids; in all other years this parenthetical instruction was omitted. If it had any effect at all, this design change should lead to lower estimates of difficulty in 1984 than in later years, ceteris paribus. Thus, any decline in difficulty would be underestimated.

The SIPP also asked respondents directly about use of mobility-related aids. In 1984, the survey asked whether individuals generally used an aid such as a wheelchair, cane, or crutches. In all other years, the question was divided into 2 parts, the first about use of a cane, crutches, or walker and the second about use of a wheelchair. On the basis of this information, we created a fifth outcome, coded 1 if an individual reported either difficulty in walking or using a mobility aid. In effect, we reclassified respondents who reported no difficulty in walking but who used a mobility aid (0.4% of the sample in 1984 and 1.3% in 1993) as having difficulty in walking. Because device questions were not asked consistently over time, this measure is likely to understate improvements in functioning; nevertheless, this outcome offers the advantage of being robust to changes in device use over time and is thus useful for sensitivity analysis.

To factor out the influence of compositional changes on trends, we included variables reflecting socioeconomic and demographic characteristics: sex, 5-year age groups (from 50–54 through 80+ years), marital status (married, widowed, separated or divorced, never married), race (White, Black, other), Hispanic (yes/no), level of educational attainment (less than high school graduation, high school graduation, more than high school), ownership of liquid financial assets (including interest-bearing checking, savings, or money market accounts or certificates of deposit), and region (Northeast, Midwest, South, West).

Statistical Analysis

We pooled the data for 1984 and 1993 and fitted weighted logistic regression models for each of the 4 functions in which having difficulty was the dependent variable. We first fitted models in which year was the only explanatory variable and calculated unadjusted rates for each year. We then included in models both year and compositional variables and calculated adjusted rates for each year. In calculating adjusted rates, we used Xie's method, which applies the coefficients to a uniform distribution of the compositional variables so that equal weights are given to each of the categories of a particular variable.[19] Thus, conclusions about trends are robust to population composition in any given year. We reported *P* values for trends based on Wald statistics adjusted to reflect the complex survey design. Comparisons of trends in unadjusted rates with trends in adjusted rates yield insight into the relative importance of compositional changes in explaining trends in functioning.

To factor out changes in the use of mobility aids on trend estimates for difficulty walking, we estimated a fifth set of unadjusted and adjusted models in which the outcome was either difficulty in walking or using a mobility device. Comparisons of these results with prevalence estimates from models in which difficulty in walking was the outcome provide insight into the sensitivity of reported trends in functioning to changes in device use.

We followed these procedures for each of 5 age groups (50–64 years, 65–79 years, 80 and older, 50 and older, 65 and older). In all adjusted models we controlled for the socioeconomic and demographic characteristics simultaneously, with one exception. Because the SIPP does not provide exact ages for respondents older than 80 years, we could not control for age in models for the 80-and-older group. Such an omission is likely to lead to underestimates of adjusted declines for this group, all else equal. Because of space limitations, we do not present logistic regression results but present only unadjusted and adjusted rates. A complete set of models is available from the authors.

Results

Unadjusted Trends

Table 1 presents reported rates of functional limitations calculated with sample weights for 1984 and 1993 for the total 50-and-older population and by compositional variables. For both years, walking 3 blocks posed the greatest challenge and seeing words in the newspaper the least.

Levels of difficulty varied considerably across compositional groups. Within each of

TABLE 1—Trends in Functioning for the US Population Aged 50 and Over, 1984 and 1993 (as % of Population)

	Difficulty Seeing Words in Newspaper		Difficulty Lifting and Carrying 10 lb		Difficulty Climbing a Flight of Stairs		Difficulty Walking 1/4 Mile or 3 City Blocks	
	1984	1993	1984	1993	1984	1993	1984	1993
Total	15.3	11.6	23.5	18.9	24.5	22.0	25.8	22.3
Age								
50–64	10.1	6.8	15.3	11.8	16.1	13.6	16.4	13.8
65–79	17.6	13.6	28.8	22.2	30.5	27.2	32.7	26.6
80 and over	38.9	29.3	54.6	43.1	53.7	45.3	58.0	50.1
Sex								
Male	13.0	10.4	16.0	13.3	19.6	17.9	21.4	18.9
Female	17.1	12.7	29.5	23.5	28.3	25.3	29.4	25.1
Marital status								
Married	11.6	8.6	17.5	13.4	19.2	16.7	20.3	17.3
Widowed	26.2	20.7	41.5	34.2	39.9	36.2	42.8	37.4
Divorced/separated	17.5	12.2	27.0	24.0	28.9	27.4	27.5	25.1
Never married	16.7	13.5	23.5	19.4	23.6	22.1	27.6	22.1
Race								
White	14.3	11.0	22.4	18.0	23.2	21.0	24.9	21.6
Black	25.7	17.7	36.1	28.2	38.4	32.5	36.8	31.1
Other	12.2	12.2	16.1	19.7	17.4	19.7	16.1	18.4
Ethnicity								
Hispanic	20.9	14.9	27.2	23.4	29.4	28.0	25.5	22.5
Non-Hispanic	15.1	11.4	23.4	18.7	24.3	21.7	25.9	22.3
Education								
<High school	23.3	20.0	34.4	30.3	36.3	36.3	37.9	36.2
High school	10.6	8.5	17.1	15.8	16.6	17.6	18.1	18.6
>High school	7.4	7.1	12.9	11.7	13.9	13.4	14.9	13.4
Ownership of liquid financial assets								
Yes	12.0	9.0	19.3	15.1	19.7	17.6	21.5	18.3
No	23.7	17.4	34.2	27.2	36.5	31.5	36.9	31.1
Region of residence								
South	19.8	14.2	26.9	20.7	29.8	25.7	29.5	24.4
West	12.8	9.9	20.8	18.4	22.4	20.8	22.6	20.5
Northeast	11.2	9.0	21.0	18.0	19.4	19.2	22.7	20.6
Midwest	14.7	11.8	23.2	17.8	23.3	20.5	26.1	22.5

the years, the highest prevalence was among the oldest, women, the unmarried, Hispanics, the least educated, and those without liquid assets. Blacks were more likely to report functional limitations than Whites; the racial group defined as "other," which had the lowest prevalence of limitation among the 3 racial groups for 1984, was a relatively small and hybrid group. Regional differences were also evident.

Clearly, the prevalence of these limitations declined over time for the 50-and-older population. Most compositional subgroups also experienced declines. The greatest improvements were generally seen in groups with the highest prevalence in 1984. Hispanics were the exception to this pattern. Also, in a few cases, there were apparent increases in difficulty.

Compositional Changes

The changes between 1984 and 1993 reported in Table 1 are unadjusted for compositional changes, which were sometimes considerable, as shown in Table 2. For all variables except sex and region, there were statistically significant changes. Aging of the population was particularly noteworthy, as were shifts in marital-status composition and increases in minority populations. Most dramatic, however, was the increase in educational attainment. Together, Tables 1 and 2 highlight the need to factor compositional changes out of functional limitation trends within a multivariate framework.

Adjusted Trends

Table 3 shows unadjusted and adjusted prevalence rates for each of the 4 functional limitations by age group. Focusing first on the unadjusted estimates, for all 4 functions and all age groups there were statistically significant declines in limitations, with the largest for the oldest group. Once compositional changes were taken into account, adjusted rates continued to show significant declines in all but 3 cases.

Although there is no statistical test for comparing changes in adjusted and unadjusted rates, in most cases the size of the decline is reduced when compositional changes are factored out. In terms of percentage points, adjusting for compositional changes dampens declines in difficulty the most for older groups; in relative terms, however, compositional change appears to matter most for those aged 50 to 64.

The trends reported thus far do not take into account the possibility that more individuals may have been using assistive technology. If individuals using aids did not perceive themselves as having difficulty, then reported improvements in functioning may actually reflect increases in device use rather than health improvements. To explore the sensitivity of our results to trends in device use, we examined the unadjusted and adjusted estimates of the proportion reporting either difficulty in walking or use of a mobility aid, shown in Table 4.

Focusing on the first 4 columns, taking into account mobility device use dampened unadjusted improvements in walking, but such declines were still statistically significant except for the oldest group. Similarly, conclusions about the effects of composition

on trends in difficulty in walking remained largely unchanged once device use was taken into account. Again, an exception is the oldest group, for which adjusted declines were not statistically significant. One interpretation of this exercise is that increased use of mobility aids played a substantial role in increasing the proportion of the oldest group who could walk a quarter of a mile, but it does not fully explain trends in walking for those aged 65 to 79.

TABLE 2—Compositional Changes (as Weighted %) in the 50+ Population, 1984–1993

	1984	1993	*P*
Age			
50–64	55.6	51.7	.000
65–79	35.8	38.3	
80 and over	8.6	10.0	
Sex			
Male	44.4	44.9	.56
Female	55.6	55.1	
Marital status			
Married	65.9	64.5	.000
Widowed	20.2	19.8	
Divorced/separated	8.5	11.3	
Never married	5.3	4.5	
Race			
White	89.2	88.1	.001
Black	9.0	9.1	
Other	1.9	2.8	
Ethnicity			
Hispanic	3.4	5.7	.000
Non-Hispanic	96.6	94.3	
Education			
<High school	43.2	31.2	.000
High school	31.3	35.3	
>High school	25.5	33.6	
Ownership of liquid financial assets			
Yes	71.9	68.4	.000
No	28.1	31.6	
Region of residence			
South	34.1	33.8	.18
West	18.4	19.2	
Northeast	22.9	21.5	
Midwest	24.6	25.5	
Total	100.0	100.0	
(n)	(13 277)	(12 716)	

Discussion

Large declines in the prevalence of 4 functional limitations—difficulty in seeing, lifting and carrying, climbing, and walking—occurred among older Americans from 1984 to 1993. The extent of improvement varied with age, with smallest absolute gains for those aged 50 to 64 and largest gains for those aged 80 and older. In most cases, the substantial shifts in the composition of the population explain only a small portion of the trends. In only 3 cases—difficulty in climbing for those aged 65 to 79 and difficulty in climbing and difficulty in walking for those aged 50 to 64—do changes in population composition appear to account for most or all of reported declines.

How do these improvements in functioning compare with recent findings regarding trends in ADL and IADL disability? Although the outcome measures and the populations studied are different, simple comparisons are possible. The analysis by Crimmins and colleagues of 1982–1993 National Health Interview Survey data for the 70-and-older noninstitutionalized population, which controlled for age and sex composition, suggests that the proportion disabled decreased from 21.1% to 19.5%, which translates into a relative annual decline of 0.7%.[9] Using 1982–1994 National Long Term Care Survey data for the 65-and-older noninstitutionalized population, Manton and colleagues found that the age-adjusted relative decline in the proportion of chronically disabled was 1.1% annually.[8] Our composition-adjusted estimates of decline are as large or larger: for the 65-and-older noninstitutionalized population, relative annual declines range from 0.9% to 2.3%, depending on the function.

What could be causing such large improvements? We focused on measures of function, which are less influenced by role expectations and living environments than measures of activity limitations used elsewhere. Further, we minimized biases likely to arise from changes in survey administration and coverage. Finally, using statistical methods, we limited the effect of changes in population composition, and for one measure—difficulty in walking—we also factored out changes in device use. After accounting for these influences, we still found large improvements in functioning for both the 50-and-older and 65-and-older populations. Thus, although we did not control for all possible factors extrinsic to physiological capability, we believe that changes in capability—whether real or perceived—do underlie these trends.

Our results have several important public health implications. First, the documented shifts in composition mean that the older population today is significantly different from that of just a decade ago. Besides functioning better, older people are likely to be better educated—a trend that will intensify in the decades to come.[20,21] All else equal, increased education will likely be associated with beneficial changes in lifestyle, access to care, ability to comply with physicians' instructions, and ability to modify one's environment—all of which may contribute to the success of future public health initiatives aimed at older Americans. At the same time, the elderly today represent a more diverse mix of racial and ethnic groups. Although Blacks have experienced improvements in functioning, their rates of limitation are substantially higher than those of Whites; in addition, the "other" racial group has experienced deterioration in some functions, so that its rates are now higher than those of Whites. As the population shares of these groups grow, so will challenges—for public health practitioners and policymakers alike—to meet their needs.

Second, we found that improvements in functioning in absolute terms have been greatest among those 80 and older. Our findings at the population level are consistent with recent studies at the individual level that demonstrate the plasticity of age-related pathology even at very old ages.[22,23] Further, the very old appear to be benefiting at least as much as others, if not more, from assistive device use, which has increased dramatically over the past decade.[24] This suggests that device use may increasingly be a viable option to bridge deficits in functioning—even at very old ages.

Third, if past improvements in functioning are indeed the result of changes in under-

TABLE 3—Unadjusted and Adjusted Rates of Functional Limitations by Age Group (% of Population Reporting Difficulty)

	Unadjusted				Adjusted[a]			
	1984	1993	Decline	*P*	1984	1993	Decline	*P*
50–64								
Seeing	10.1	6.8	3.4	.000	11.1	7.8	3.2	.000
Lifting	15.3	11.8	3.5	.000	16.6	13.5	3.2	.001
Climbing	16.1	13.6	2.4	.004	16.2	14.7	1.5	.11
Walking	16.4	13.8	2.6	.002	15.2	13.7	1.4	.11
65–79								
Seeing	17.6	13.6	4.1	.000	21.1	17.0	4.1	.000
Lifting	28.8	22.3	6.5	.000	30.5	24.6	5.9	.000
Climbing	30.5	27.2	3.2	.01	32.3	30.4	1.9	.20
Walking	32.7	26.6	6.1	.000	29.9	25.4	4.5	.001
80+								
Seeing	38.9	29.3	9.6	.000	35.2	27.0	8.2	.002
Lifting	54.6	43.1	11.5	.000	51.5	41.0	10.5	.000
Climbing	53.7	45.3	8.4	.003	47.2	40.6	6.6	.03
Walking	58.0	50.1	7.9	.005	41.5	35.9	5.6	.05
50+								
Seeing	15.3	11.6	3.7	.000	18.6	14.1	4.5	.000
Lifting	23.5	18.9	4.6	.000	26.7	21.3	5.4	.000
Climbing	24.5	22.0	2.5	.001	27.2	24.8	2.4	.006
Walking	25.8	22.3	3.5	.000	25.0	21.7	3.3	.000
65+								
Seeing	21.7	16.8	4.9	.000	24.7	19.6	5.1	.000
Lifting	33.8	26.6	7.2	.000	35.6	28.5	7.1	.000
Climbing	34.9	31.0	4.0	.001	36.4	33.5	3.0	.03
Walking	37.6	31.5	6.1	.000	33.4	28.6	4.8	.000

[a]Adjusted for age, sex, marital status, race, ethnicity, education, ownership of liquid financial assets, and region of residence.

lying physiological capability, then we need to learn more about the specific interventions and behavioral changes that most likely underlie these trends. One study of an elderly population attributed 35% to 45% of the difficulty in climbing stairs, walking, and carrying bundles to osteoarthritis of the knee, stroke, and depressive symptomatology.[25] Conditions that most commonly threaten the vision of older Americans include macular degeneration, glaucoma, diabetic retinopathy, and cataracts.[26] Advances in the prevention and treatment of these and other conditions could have major consequences for future functioning. To the extent that optimal strategies to postpone or ameliorate such conditions are adopted, functioning may continue to improve.

That said, even if we are successful in further reducing the prevalence of disability, such success does not necessarily imply reductions in the numbers of people with limitations. Given the continuing growth in the older population, planning for the needs of this population remains a challenge. But in relative terms, if these prevalence trends do continue, the future will not be as daunting as suggested by earlier work that found no improvements. With continued declines, relatively fewer older people will need medical care and support services associated with limitations, and more should be able to work and live independently. □

Acknowledgments

This research was supported by the National Institute on Aging's supplement to RAND's National Institute for Child Health and Human Development population center grant P50 HD12639 and by RAND.

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TABLE 4—Unadjusted and Adjusted Rates of Difficulty in Walking and Difficulty in Walking or Use of Assistive Devices

	Unadjusted				Adjusted[a]			
	1984	1993	Decline	*P*	1984	1993	Decline	*P*
50–64								
Difficulty in walking	16.4	13.8	2.6	.002	15.2	13.7	1.4	.11
Difficulty in walking or device use	16.5	14.4	2.2	.01	15.3	14.4	1.0	.28
65–79								
Difficulty in walking	32.7	26.6	6.1	.000	29.9	25.4	4.5	.001
Difficulty in walking or device use	33.1	28.0	5.1	.000	30.6	27.2	3.5	.01
80+								
Difficulty in walking	58.0	50.1	7.9	.005	41.5	35.9	5.6	.05
Difficulty in walking or device use	60.1	54.9	5.2	.07	44.0	40.9	3.0	.31
50+								
Difficulty in walking	25.8	22.3	3.5	.000	25.0	21.7	3.3	.000
Difficulty in walking or device use	26.2	23.7	2.6	.001	25.7	23.4	2.3	.005
65+								
Difficulty in walking	37.6	31.5	6.1	.000	33.4	28.6	4.8	.000
Difficulty in walking or device use	38.3	33.6	4.7	.000	34.5	31.1	3.4	.009

[a]Adjusted for age, sex, marital status, race, ethnicity, education, ownership of liquid financial assets, and region of residence.

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