SPECIAL ARTICLE

Health, Life Expectancy, and Health Care Spending among the Elderly

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ABSTRACT

BACKGROUND

Life expectancy among the elderly has been improving for many decades, and there is evidence that health among the elderly is also improving. We estimated the relation of health status at 70 years of age to life expectancy and to cumulative health care expenditures from the age of 70 until death.

METHODS

Using the 1992–1998 Medicare Current Beneficiary Survey, we classified persons' health according to functional status and whether or not they were institutionalized and according to self-reported health. We used multistate life-table methods and microsimulation to estimate life expectancy for persons in various states of health. We linked annual health care expenditures with transitions between health states.

RESULTS

Elderly persons in better health had a longer life expectancy than those in poorer health but had similar cumulative health care expenditures until death. A person with no functional limitation at 70 years of age had a life expectancy of 14.3 years and expected cumulative health care expenditures of about $136,000 (in 1998 dollars); a person with a limitation in at least one activity of daily living had a life expectancy of 11.6 years and expected cumulative expenditures of about $145,000. Expenditures varied little according to self-reported health at the age of 70. Persons who were institutionalized at the age of 70 had cumulative expenditures that were much higher than those for persons who were not institutionalized.

CONCLUSIONS

The expected cumulative health expenditures for healthier elderly persons, despite their greater longevity, were similar to those for less healthy persons. Health-promotion efforts aimed at persons under 65 years of age may improve the health and longevity of the elderly without increasing health expenditures.

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Life expectancy among the elderly has been improving for many decades,[1] and there is evidence that the health of the elderly has also been improving.[2-4] The coming influx of the baby-boom generation into Medicare and the projected depletion of the Medicare trust fund by 2029[5] have raised interest in the effects of trends in longevity and health on Medicare and on total health care spending for the elderly.[6] Some studies have suggested that the improving health of the elderly will moderate fiscal pressures on Medicare.[7] The 2000 Medicare Technical Review Panel recommended that the health status of the Medicare population be incorporated into projections of trust fund balances.[8] There is some evidence that longer life, accompanied by better health, may not cause a significant increase in health care spending.[2,9-12] However, these studies did not directly address the question of the relation among health, longevity, and medical expenditures.

We estimated life expectancy and health care expenditures for the elderly according to health states. For instance, we asked how long a person who was 70 years old and in good health might live and what health care expenditures such a person would incur up to the time of death, as compared with a person of the same age who was in poor health. What is the trade-off between better health, which means lower annual expenditures, and longer life, which means more years in which to accumulate costs?

We used multistate life-table methods to estimate life expectancy according to demographic variables and health state and linked health care spending with each health state. Multistate methods have been used to estimate life expectancy in various health states.[13,14] We used the 1992–1998 Cost and Use files of the Medicare Current Beneficiary Survey, sponsored by the Centers for Medicare and Medicaid Services.

METHODS

SELECTION OF DATA

The Medicare Current Beneficiary Survey has been conducted continuously since 1991. The survey sample was drawn from Medicare enrollment files. Because Medicare covers over 96 percent of persons in the United States who are 65 years of age or older, the survey provides a very good representation of this population, especially because it includes institutionalized persons. The survey gathers information from about 12,500 Medicare beneficiaries on sociodemographic characteristics, use and costs of services covered by Medicare (services provided by inpatient and outpatient hospitals, skilled nursing facilities, hospice programs, physicians, and other practitioners, as well as some home health care) and services not covered (e.g., prescription drugs, nursing home care below the skilled nursing level as defined by Medicare, and dental care). Information on use and expenditures is gathered in three in-person interviews per year with a recall period of four months; memory aids (e.g., calendars and statements from Medicare and other insurers) are used to ensure completeness and accuracy. Expense data on Medicare-reimbursed services and mortality data are taken directly from Medicare records. Events reported by respondents are linked to claims, and imputation procedures are used to develop information on health care expenditures that is as accurate as possible.[15-17]

The Medicare Current Beneficiary Survey follows a rotating panel design in which one third of the sample is replaced each year. Information on health status is gathered each fall. Persons included in the sample who neither drop out of the survey nor die have four fall interviews. If a respondent drops out after a fall interview and dies during the next year, the data for that person are included so that mortality rates are not underestimated. The response rate for the survey is about 70 percent.

We used survey data from 1992 through 1998. Our study was restricted to persons who were 70 years of age or older to avoid bias, because many persons newly enrolled in Medicare at 65 to 69 years of age may not be eligible to be interviewed in their first year of enrollment. Our study included 16,964 persons, with a total of 50,477 person-years.

We classified health status on the basis of responses to questions about five activities used as measures of physical functioning, developed by Nagi,[18] six instrumental activities of daily living, and six activities of daily living. These measures are frequently used to characterize the health of the elderly.[2,4,19,20] The five Nagi activities are stooping, crouching, or kneeling; lifting or carrying objects weighing up to 6 kg (10 lb); extending the arms above the shoulder; grasping small objects; and walking two to three blocks. Respondents are asked how much difficulty, if any, they have with the activity, and the answers range from "no difficulty at all" to "not able to do it." We counted persons who

responded that they had any difficulty or that they were unable to perform the activity as having a limitation in physical functioning.

The six instrumental activities of daily living are using the telephone, doing light housework, doing heavy housework, preparing meals, shopping for personal items, and managing money. The six activities of daily living are bathing or showering, dressing, eating, getting into or out of a bed or a chair, walking, and using the toilet. For the purpose of our study, persons who reported having any difficulty or not being able to perform the activity for reasons of health were considered to have a limitation in the activity.

We defined states of health according to the following classification: no limitations, at least one Nagi limitation but no other limitations, a limitation in at least one instrumental activity of daily living but no limitations in activities of daily living, a limitation in at least one activity of daily living, institutionalization (e.g., in a nursing home), or death. Such hierarchical classifications are similar to those used in many disability models.[6,21,22] There were 15,278 changes in health state and 3462 deaths.

Active life was defined as life with no reported limitations or only Nagi limitations. Most institutionalized persons were in nursing homes, and most nursing home residents received assistance with one or more activities of daily living.[23] As a measure of health in separate analyses, we also used self-rated health status, for which responses ranged from excellent to poor.

STATISTICAL ANALYSIS

We used multistate life-table methods to estimate total and active life expectancy. Multistate models allow for transitions among all states of health. Given our classification of functional status or self-rated health status into five states of health and death, there were 25 possible transitions from one state to another. Age-specific, first-order Markov transition probabilities were estimated with the use of a multivariate hazard model, with age and sex or

Table 1. Probability of a Change in Functional Status after One Year among Medicare Beneficiaries 75 and 85 Years of Age, as Computed with the Use of Multivariate Hazard Models, for the Years 1992 through 1998 Combined.*

Initial Functional State	Functional State One Year Later					
	No Limitation	Nagi Limitation	IADL Limitation	ADL Limitation	Institutionalized	Dead
	percent					
At 75 yr						
No limitation	80.4	11.2	3.9	1.6	0.5	2.5
Nagi limitation	15.7	66.6	7.2	5.0	1.3	4.2
IADL limitation	8.5	13.5	60.0	8.5	3.1	6.4
ADL limitation	3.2	8.2	8.4	61.9	9.2	9.1
Institutionalized	0.7	1.4	2.2	9.0	69.9	16.7
At 85 yr						
No limitation	66.9	14.1	7.1	4.7	2.1	5.2
Nagi limitation	11.8	58.1	10.4	9.4	3.6	6.9
IADL limitation	5.0	8.9	57.5	13.1	6.0	9.6
ADL limitation	2.0	4.9	6.5	61.6	13.0	12.1
Institutionalized	0.3	0.6	1.1	6.5	70.1	21.4

* IADL denotes instrumental activities of daily living, and ADL activities of daily living. A Nagi limitation was defined as difficulty performing or inability to perform at least one of five activities: stooping, crouching, or kneeling; lifting or carrying objects weighing up to 4.5 kg (10 lb); extending the arms above the shoulder; grasping small objects; and walking two to three blocks. A limitation in IADL was defined as difficulty performing or inability to perform at least one of six activities: using the telephone, doing light housework, doing heavy housework, preparing meals, shopping for personal items, and managing money. An ADL limitation was defined as difficulty performing or inability to perform at least one of six activities: bathing or showering, dressing, eating, getting in or out of bed or a chair, walking, and using the toilet. Institutionalized persons were those living in a long-term care facility, defined in the Medicare Current Beneficiary Survey as a facility with three or more beds that provides long-term care throughout the facility or in a separate unit.

age and race as the covariates — an approach that is similar to that used in previous studies.[13,24] The 25 equations, one for each possible transition, produced age-specific matrixes of annual transition probabilities. Examples of these probabilities at 75 and 85 years of age are shown in Table 1. As the table shows, the majority of persons at those ages will be in the same state of health after one year. The probability of institutionalization or death increases as the functional state worsens and is higher for those who are 85 years old at all initial functional states. Hazard estimates were weighted to reflect the sample design with the use of cross-sectional survey weights.

Health-expenditure matrixes were structured in a similar manner to the transition matrixes. Each cell of the matrix contains the average expenditures incurred when a person changed (or did not change) from one of the five initial health states to one of the six ending states. Expenditures were not modeled but were categorized according to age, sex, race, and type of transition. The expenditures associated with a change in health status from the fall of one year to the fall of the next year were the calendar-year expenditures for the later year. Expenditures were adjusted for inflation to 1998 dollars with the use of the rate of increase in Medicare per capita expenditures.[9]

We then used microsimulation to simulate a cohort (of 100,000 persons 70 years of age) whose changes in health status were governed by these estimated probabilities, and we recorded life expectancy and health care expenditures. The simulation approach is similar to an approach used previously,[14] but we extended its application by associating annual health care expenditures with changes in health status.

Our estimates of life expectancy at the age of 70 years are somewhat lower (by 7 percent or less) than those of the National Vital Statistics System.[25] Other studies in which similar methods were used have also produced different estimates from those of the National Vital Statistics System.[24,26] This difference is likely to be due to our use of multistate life-table methods in our analysis. Health-state transition probabilities were estimated with 25 separate hazard-model equations and then used to produce a single estimate of life expectancy. Use of the same data with single-decrement life-table methods produces estimates of total life expectancy that are similar to those published by the National Vital Statistics System.

Table 2. Years Spent in Different States of Health and Cumulative Health Care Expenditures from 70 Years of Age until Death, According to Sex and Race.*

Functional State	Years in Functional State (95% CI)	Expenditures (Thousands of $)†	
		Total (95% CI)	Average per yr
All persons			
Total	13.2 (12.8–13.6)	140.7 (135.4–146.1)	10.7
Active	6.9 (6.6–7.1)	37.0 (35.2–38.8)	5.4
No limitation	2.5 (2.3–2.7)	11.5 (10.6–12.4)	4.6
Nagi limitation	4.4 (4.2–4.6)	25.5 (23.9–27.0)	5.8
IADL limitation	1.8 (1.7–1.9)	15.5 (14.4–16.7)	8.5
ADL limitation	3.7 (3.5–3.9)	51.9 (49.0–54.8)	14.1
Institutionalized	0.8 (0.7–0.9)	36.3 (32.4–40.2)	45.4
Men			
Total	11.8 (11.3–12.3)	122.0 (115.7–128.2)	10.4
Active	7.4 (7.0–7.8)	47.4 (44.2–50.6)	6.4
No limitation	2.9 (2.7–3.2)	16.1 (14.3–17.9)	5.5
Nagi limitation	4.5 (4.2–4.7)	31.3 (28.6–34.0)	7.0
IADL limitation	1.3 (1.2–1.4)	12.5 (10.9–14.2)	9.7
ADL limitation	2.7 (2.5–2.9)	43.6 (40.0–47.2)	16.1
Institutionalized	0.4 (0.3–0.5)	18.4 (14.7–22.1)	47.3
Women			
Total	14.3 (13.8–14.8)	154.6 (146.9–162.3)	10.8
Active	6.5 (6.2–6.8)	29.2 (27.4–31.1)	4.5
No limitation	2.2 (2.0–2.4)	8.4 (7.5–9.3)	3.8
Nagi limitation	4.3 (4.1–4.6)	20.8 (19.2–22.4)	4.8
IADL limitation	2.2 (2.1–2.4)	17.7 (16.1–19.3)	7.9
ADL limitation	4.5 (4.2–4.7)	58.4 (54.2–62.5)	13.1
Institutionalized	1.1 (1.0–1.2)	49.3 (43.4–55.2)	45.2
White race			
Total	13.5 (13.1–13.9)	141.2 (135.5–146.8)	10.5
Active	7.2 (6.9–7.4)	39.1 (37.0–41.1)	5.4
No limitation	2.6 (2.5–2.8)	12.2 (11.2–13.3)	4.7
Nagi limitation	4.6 (4.4–4.7)	26.8 (25.1–28.6)	5.9
IADL limitation	1.8 (1.7–2.0)	15.9 (14.7–17.2)	8.7
ADL limitation	3.7 (3.5–3.9)	50.4 (47.3–53.5)	13.7
Institutionalized	0.8 (0.7–0.9)	35.7 (31.7–39.8)	44.1
Black race			
Total	11.5 (10.4–12.6)	137.0 (121.6–152.4)	11.9
Active	5.4 (4.7–6.1)	24.2 (18.0–30.4)	4.5
No limitation	2.1 (1.7–2.5)	8.2 (5.8–10.6)	3.9
Nagi limitation	3.3 (2.8–3.8)	16.0 (12.6–19.3)	4.9
IADL limitation	1.6 (1.3–1.9)	13.4 (9.5–17.4)	8.4
ADL limitation	3.9 (3.2–4.5)	64.7 (53.6–75.8)	16.8
Institutionalized	0.6 (0.4–0.9)	34.7 (24.7–44.7)	54.2

* Data are for the years 1992 through 1998 combined. CI denotes confidence interval, IADL instrumental activities of daily living, and ADL activities of daily living. Total refers to total life expectancy.
† Expenditures are in 1998 dollars.

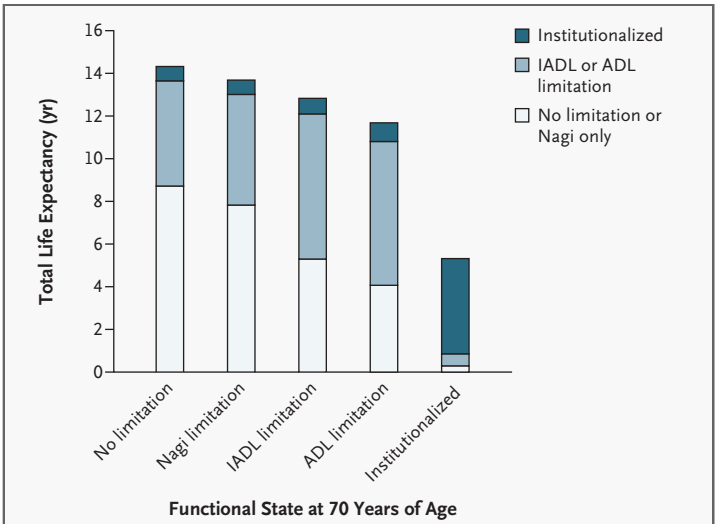

Figure 1. Life Expectancy at 70 Years of Age According to Functional State at the Age of 70.

The shading in the bars indicates the expected number of years lived in various functional states. For example, a person with no limitations at the age of 70 is estimated to live an additional 14.3 years, on average. Of those 14.3 years, 0.7 will be spent in an institution, 4.9 with a limitation in at least one instrumental activity of daily living (IADL) or activity of daily living (ADL), and 8.7 (61 percent of total life expectancy) with no limitation or only Nagi limitations. Instrumental activities of daily living, activities of daily living, and Nagi limitations are described in the Methods section.

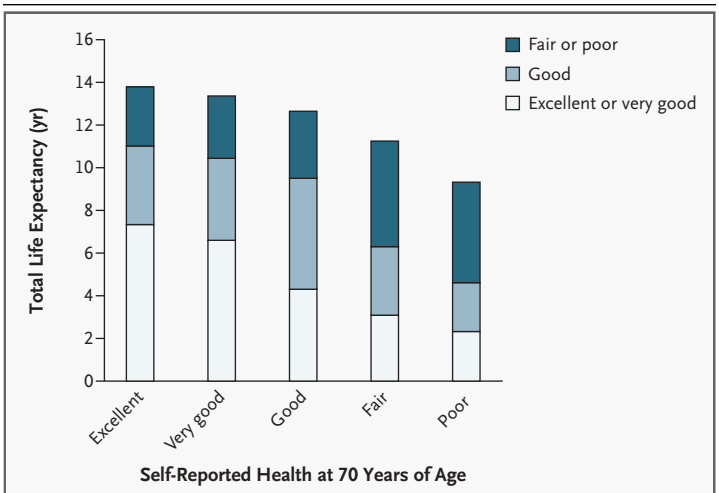

Figure 2. Life Expectancy at 70 Years of Age According to Self-Reported Health at the Age of 70.

The shading in the bars indicates the expected number of years lived in various states of health. For example, a person who reports excellent health at the age of 70 is estimated to live an additional 13.8 years, on average. Of those 13.8 years, 2.7 will be lived in fair or poor health, 3.7 in good health, and 7.3 (53 percent of total life expectancy) in very good or excellent health.

Because our estimates of life expectancy and cumulative expenditures are complex functions of the transition probabilities, we used the bootstrap method to estimate standard errors.[27] We sampled respondents from 67 primary sampling-unit groups. Within each group, we sampled Medicare beneficiaries with replacement with size equal to one less than the original group size. We then estimated the transition probabilities of this bootstrap sample with multivariate hazard models, as described above, and computed average life expectancy and expenditures on the basis of simulations of 25,000 persons at the age of 70. We performed this set of calculations 1000 times. Standard errors were computed from these 1000 estimates. Comparisons between groups were performed with the use of two-sample t-tests. All reported differences are significant at the level of $P \leq 0.05$ for a two-sided test. The relative standard errors for the functional state or self-reported state of health in the figures were less than 10 percent, except that in the figures showing life expectancy and expenditures in relation to functional state, the relative standard errors for years lived and expenditures incurred in noninstitutional states for persons institutionalized at age 70 were about 25 percent.

RESULTS

At 70 years of age, 28 percent of the study population had no functional limitations, 40 percent had only Nagi limitations, 12 percent had at least one limitation in an instrumental activity of daily living but no limitations in activities of daily living, 18 percent had a limitation in an activity of daily living, and 2 percent were institutionalized (data not shown). At age 70, total life expectancy was 13.2 years, of which 52 percent were active years (i.e., almost 7 years with either no limitations or only Nagi limitations) (Table 2). Total expenditures for medical care from age 70 to death were about $140,700. The average expenditures per year increased with worsening health status, from about $4,600 for persons reporting no limitations to about $45,400 for institutionalized persons. The expected expenditures for men were lower than those for women. Men actually had higher expenditures per year in every health state but had lower total expenditures because of a shorter life expectancy and also fewer years in the health states that incurred the greatest expenditures. Blacks had both a lower overall life expectancy and a lower active life expectancy than whites, but had similar levels of expenditures.

Expenditures incurred while a person had limitations in activities of daily living or was in an institution accounted for a large part of total costs from 70 years of age until death. For example, a person at age 70 could expect to live 34 percent of remaining life (4.5 years) with limitations in activities of daily living or in an institution but to incur 63 percent of medical expenditures (about $88,200) in these health states (Table 2).

ESTIMATES OF LIFE EXPECTANCY AND HEALTH CARE EXPENDITURES ACCORDING TO HEALTH STATUS

Persons in better health at 70 years of age had a longer life expectancy than those in worse health (Fig. 1). Persons with no limitations had the longest life expectancy, and institutionalized persons the shortest. Persons with better health were also expected to be active for a longer period. For example, the 28 percent of persons 70 years of age who had no limitations could expect to be active for 61 percent of their remaining years. In contrast, the 18 percent of persons 70 years of age who had a limitation in an activity of daily living could expect to be active for only 35 percent of their remaining 11.6 years.

Persons who were living in the community at age 70, regardless of their state of health, could expect to spend about 0.7 year in an institution. Persons in better health at age 70 might be expected to spend less time in an institution than persons with functional limitations, but persons in good health live longer, and longevity is associated with lack of social support (e.g., widowhood) and frailty, and thus with a high risk of institutionalization. However, in our study the annual risk of institutionalization was lower for those in better health at 70 years of age; they lived longer, but the expected time spent in an institution was the same as for persons in poorer health.

The same pattern of longer life for persons in better health was found when we used self-reported health status as a measure of health (Fig. 2). Those who reported excellent health at 70 years of age had a life expectancy of 13.8 years, with most of that time spent in excellent or very good health. Those who reported poor health had a life expectancy of 9.3 years, with most of that time spent in fair or poor health.

Persons without functional limitations at 70 years of age who lived longer did not incur higher health care expenditures (Fig. 3). Health care expenditures for persons 70 years of age or older who were living in the community at 70 years of age varied little according to initial health status. Persons without functional limitations incurred an estimated $136,000 in medical expenses from age 70 until death, as compared with an estimated $145,000 for persons with a limitation in at least one activity of daily living. Only those who were initially in an institution had much higher expenditures, which were the consequence of high nursing home costs. When we categorized persons only according to functional status, with no separate category for those institutionalized, and defined functional status as both having difficulty and receiving help with instrumental activities of daily living or activities of daily living, those in better functional states had greater longevity, but there was little variation in expected expenditures (data not shown). Similarly, health care expenditures from the age of 70 years and onward varied little according to the initial self-reported health state, despite differences in longevity (Fig. 4).

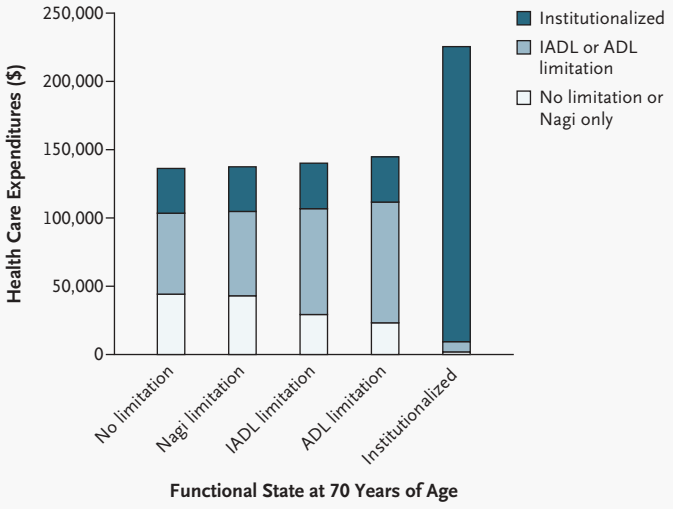

Figure 3. Expected Expenditures for Health Care from 70 Years of Age until Death According to Functional State at the Age of 70.

Expenditures are in 1998 dollars. The shading in the bars indicates estimated health care expenditures for persons in various functional states. For example, a person with no limitation at the age of 70 is estimated to have cumulative health care expenditures of about $136,000 from the age of 70 until death. Of this amount, about $32,000 will be spent while the person is institutionalized, about $60,000 for care while the person has a limitation in at least one instrumental activity of daily living (IADL) or activity of daily living (ADL), and about $44,000 (32 percent of total expenditures) for care in the absence of limitations or with only Nagi limitations. Instrumental activities of daily living, activities of daily living, and Nagi limitations are described in the Methods section.

DISCUSSION

By linking data on medical care expenditures to estimates of life expectancy for persons 70 years of age in various health states, we estimated the relations among health, longevity, and expected health care spending. Our analysis shows not only that persons in good health at 70 years of age can expect to live longer and to have more years of good health than those in poor health at age 70, but also that their total expected medical care expenses appear to be no greater than those for less healthy persons, even though healthier persons live longer. Lower annual expenditures from the age of 70 until death among healthier persons offset the greater time they have to accumulate health care costs — a finding hinted at in earlier research.[11,28]

The possibility that better health among the elderly will moderate the expected increases in medical care spending for the elderly has been suggested by earlier studies.[6,7] Our results, however, raise questions about this possibility. For persons who reach the age of 70 in better health and who have more remaining years of life, the cumulative health care expenditures until death are similar to those for persons in poor health at the age of 70.

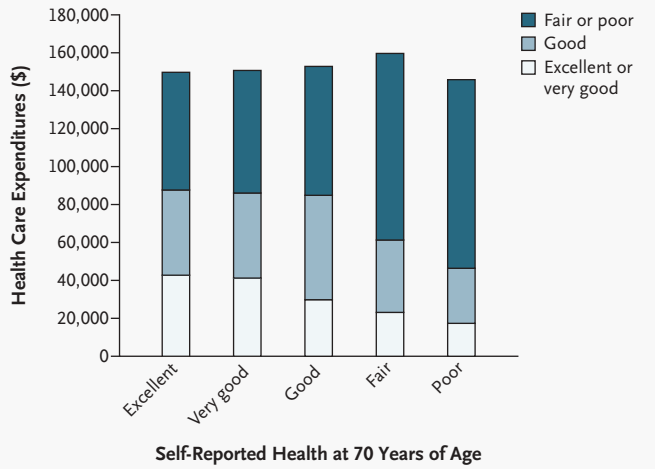

Figure 4. Expected Expenditures for Health Care from 70 Years of Age until Death According to Self-Reported Health at the Age of 70.

Expenditures are in 1998 dollars. The shading in the bars indicates health care expenditures for persons in various states of health. For example, a person reporting excellent health at the age of 70 is estimated to have cumulative health care expenditures of about $150,000 from the age of 70 until death. Of this amount, about $62,000 will be spent while the person is in fair or poor health, about $45,000 while the person is in good health, and about $43,000 (29 percent of total expenditures) while the person is in very good or excellent health.

There are a number of limitations to our study. First, the age-specific probabilities of changes in health states that we used to produce our estimates were based on the period from 1992 to 1998. We did not take into account demographic and social changes or changes in medical care that might affect the relation between health status and expenditures. For example, changes are now occurring in long-term care, including a decrease in informal care, an increase in formal paid care, and an increase in the number of assisted-living facilities.[29,30] It is unclear how these changes may affect the costs of institutionalization, which make up a large part of health care costs for the elderly. In addition, future medical advances may increase costs while lowering rates of disability. Thus, caution is needed when projecting these patterns into the future.

Second, life-table methods assume a first-order Markov transition process. This assumption ignores the relation between the current health state and past states, except for the immediately preceding state. Third, our measures of health do not capture dimensions such as cognitive health, emotional health, or pain. Cognitive status is an important dimension of health in the elderly[31]; pain is also important — for instance, in the care of patients with cancer.[32] Finally, our analysis captures only formal health care, not informal caregiving, which can be costly, both financially and emotionally, for family members of an elderly person.[33]

Our study shows clearly that for the elderly, better health results in longer life but not in higher health care expenditures. Of course, there may be health care costs before the age of 70 years that enable people to reach old age in good health and in a good functional state. More research is needed to understand these factors.

It is not clear what the trends in the health of the elderly will be in the future. Favorable trends among the elderly in the areas of smoking cessation, education, and exercise compete with other trends toward increases in obesity and asthma among those under the age of 65. In any event, we believe that the patterns found in our study suggest that health-promotion efforts in the nonelderly population that have payoffs in better health and longer life for the elderly will not increase health care spending among the elderly.

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REFERENCES

1. Health, United States, 2001: with urban and rural health chart book. Hyattsville, Md.: National Center for Health Statistics, 2001. (DHHS publication no. 01-1232.)
2. Manton KG, Gu X. Changes in the prevalence of chronic disability in the United States black and nonblack population above age 65 from 1982 to 1999. Proc Natl Acad Sci U S A 2001;98:6354-9.
3. Freedman VA, Martin LG. Understanding trends in functional limitations among older Americans. Am J Public Health 1998; 88:1457-62.
4. Schoeni RF, Freedman VA, Wallace RB. Persistent, consistent, widespread, and robust? Another look at recent trends in old-age disability. J Gerontol B Psychol Sci Soc Sci 2001;56:S206-S218.
5. Board of Trustees, annual report, March 19, 2001. Washington, D.C.: Federal Hospital Insurance Trust Fund, 2001.
6. Waidmann TA, Liu K. Disability trends among elderly persons and implications for the future. J Gerontol B Psychol Sci Soc Sci 2000;55:S298-S307.
7. Singer BH, Manton KG. The effects of health changes on projections of health service needs for the elderly population of the United States. Proc Natl Acad Sci U S A 1998; 95:15618-22.
8. Centers for Medicare and Medicaid Services. Technical panel to review Medicare trustees report. (Accessed August 18, 2003, at http://www.hcfa.gov/pubforms/actuary/technicalpanel/TOC.htm.)
9. Spillman BC, Lubitz J. The effect of longevity on spending for acute and long-term care. N Engl J Med 2000;342:1409-15.
10. Daviglus ML, Liu K, Greenland P, et al. Benefit of a favorable cardiovascular risk-factor profile in middle age with respect to Medicare costs. N Engl J Med 1998;339: 1122-9.
11. Hodgson TA. Cigarette smoking and lifetime medical expenditures. Milbank Q 1992;70:81-125.
12. Miller T. Increasing longevity and Medicare expenditures. Demography 2001;38: 215-26.
13. Crimmins EM, Hayward MD, Saito Y. Differentials in active life expectancy in the older population of the United States. J Gerontol B Psychol Sci Soc Sci 1996;51:S111-S120.
14. Laditka SB, Wolf DA. New methods for analyzing active life expectancy. J Aging Health 1998;10:214-41.
15. Sharma R, Chan S, Liu H, Ginsberg C. Health and health care of the Medicare population: data from the 1997 Medicare Current Beneficiary Survey. Rockville, Md.: Westat, 2001.
16. Eppig FJ, Chulis GS. Matching MCBS (Medicare Current Beneficiary Survey) and Medicare data: the best of both worlds. Health Care Financ Rev 1997;18:211-29.
17. Centers for Medicare and Medicaid Services. Linking survey data and Medicare claims, 2003. (Accessed August 18, 2003, at http://cms.hhs.gov/mcbs/Linkage.asp.)
18. Nagi SZ. An epidemiology of disability among adults in the United States. Milbank Mem Fund Q 1976;54:439-67.
19. Katz S, Branch LG, Branson MH, Papsidero JA, Beck JC, Greer DS. Active life expectancy. N Engl J Med 1983;309:1218-24.
20. Guralnik JM, Land KL, Blazer D, Fillenbaum GG, Branch LG. Educational status and active life expectancy among older blacks and whites. N Engl J Med 1993;329:110-6.
21. Pope AM, Tarlov AR, eds. Disability in America: toward a national agency for prevention. Washington, D.C.: National Academy Press, 1991.
22. Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994;38:1-14.
23. Gabrel CS. Characteristics of elderly nursing home current residents and discharges: data from the 1997 National Nursing Home Survey. Advance data from vital and health statistics. No. 312. Hyattsville, Md.: National Center for Health Statistics, 2000. (DHHS publication no. (PHS) 2000-1250 0-0308.)
24. Crimmins EM, Hayward MD, Saito Y. Changing mortality and morbidity rates and the health status and life expectancy of the older population. Demography 1994; 31:159-75.
25. Vital statistics of the United States, 1995: preprint of volume II, Mortality, part A, section 6: life tables. Hyattsville, Md.: National Center for Health Statistics, 1998. (DHHS publication no. (PHS) 98-1147.)
26. Land KC, Guralnik JM, Blazer DG. Estimating increment-decrement life tables with multiple covariates from panel data: the case of active life expectancy. Demography 1994; 31:297-319.
27. Shao J, Tu D. The jackknife and bootstrap. New York: Springer Verlag, 1995.
28. Vita AJ, Terry RB, Hubert HB, Fries JF. Aging, health risks and cumulative disability. N Engl J Med 1998;338:1035-41.
29. Spillman BC, Pezzin LE. Potential and active family caregivers: changing networks and the "sandwich generation." Milbank Q 2000;78:347-74, 339.
30. Wright B. Assisted living in the United States. AARP Public Policy Institute fact sheet. Washington, D.C.: AARP, 2001. (Accessed August 18, 2003, at http://research.aarp.org/il/fs62r_assist.html.)
31. Lentzner H, Pamuk ER, Rhodenhiser EP, Rothenberg R, Powell-Griner E. The quality of life in the year before death. Am J Public Health 1992;82:1093-8.
32. McCarthy EP, Phillips RS, Zhong Z, Drews RE, Lynn J. Dying with cancer: patients' function, symptoms, and care preferences as death approaches. J Am Geriatr Soc 2000;48:Suppl 5:S110-S121.
33. Langa KM, Chernew ME, Kabeto MU, et al. National estimates of the quantity and cost of informal caregiving for the elderly with dementia. J Gen Intern Med 2001;16: 770-8.

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