Syracuse University
Maxwell School of Citizenship and Public Affairs | Center for Policy Research

Policy Brief

DISTINGUISHED LECTURER IN AGING SERIES

American Longevity: Past Present, and Future

Samuel H. Preston

No. 7/1996

Samuel Preston is Frederick J. Warren Professor of Demography at the University of Pennsylvania and Director of its Population Studies Center. A 1968 Ph.D. in Economics from Princeton University, he has also been a faculty member at the University of California, Berkeley, and the Universi ty of Washington. He is past president of the Population Association of America and is a member of the National Academy of Sciences, where he chaired the Committee on Population.

The Policy Brief series is a collection of essays on current public policy issues in aging, health, income security, metropolitan studies and related research done by or on behalf of the Center for Policy Research at the Maxwell School of Citizenship and Public Affairs.

Single copies of this publication may be obtained at no cost from the Center for Policy Research, Maxwell School, 426 Eggers Hall, Syracuse, NY 13244-1090.

American Longevity:

Past, Present, and Future

Samuel H. Preston

A new book by Julian Simon that he modestly calls *The State of Humanity* devotes its first three chapters to longevity. I believe that this emphasis is proper. How long we live, and how long members of our families and social groups live, is extraordinarily important to us. It's not a subject of daily discussion, but it would be if we were threatened with a return to earlier conditions. Unfortunately, the subject of longevity falls between the cracks of academe and has received far less attention than it warrants.

We are all aware, at least dimly, that people are living longer than they used to. The numbers are impressive: at the turn of the century, life expectancy at birth in the United States was 48 years; it's now 76 years. Since life expectancy during the Stone Age was in the range of 20 to 30 years, it is clear that a majority of the cumulative advances have taken place in the short span of the 20th century. Without the improvements during this century, half of us would not be here: a quarter of the present U.S. population would have been born and died, and another quarter would never have been born because of the pre-reproductive death of a mother, grandmother, or great grandmother (White and Preston 1996). In developing countries, nearly all of the improvements in longevity have occurred in this century.

How these gains were achieved has important implications for public policy; how large future gains will be is the single most important area of uncertainty affecting the fiscal viability of our "old age welfare state." These are the two related issues that I focus on in this policy brief.

The Sources of Gains in U.S. Longevity

There are basically three explanations of the gains that have occurred. One, probably favored by most lay people, is that the advances are primarily a product of *Big Medicine*: doctors and hospitals, drugs and therapies. This explanation is almost certainly wrong. It was effectively demolished by Thomas McKeown (1976), a British medical historian studying the much better mortality records available in England and Wales. He showed that the mortality decline was primarily attributable to declines in infectious and parasitic diseases and that, for disease after disease, the bulk of the decline had occurred before any medicine or therapy was available to combat the disease. One of his figures is reproduced in Figure 1. Tuberculosis, the single most important disease, had declined by some 80% before effective medical intervention was available. This type of demonstration has been repeated for the United States.

McKeown argued that, if it wasn't medicine, it must have been standards of living. In particular, he attributed the bulk of the mortality decline to improved nutrition. Unfortunately, he presented no direct evidence about nutrition's role and his process-of-elimination reasoning failed to eliminate some obvious alternatives.

Recently joining forces with McKeown is Robert Fogel, an economic historian and Nobel laureate. Fogel (e.g., 1994) *does* present direct evidence about the role of nutrition. However, it's evidence about nutritional status rather than nutritional intake or diet. Fogel presents indisputable evidence about the rise in heights during this century and introduces data from Norway showing that taller people live longer. The strength of this relationship is such, he argues, that one can "explain" the majority of the gain in longevity since 1870 by reference to rising heights.

I don't find this argument convincing because I believe that height and mortality are joint products of the same set of influences, rather than causally related to one another. In addition to diet, both are profoundly affected by the disease environment of childhood. The most careful studies of child growth patterns have been done at the Institute for Nutrition in Central America and Panama (INCAP). Children in this region have diarrheal disease approximately a third of the time. The director of INCAP, Leonardo Mata, summarized his multivariate analysis of child growth patterns in the following way:

> Factors of great significance for growth are infection and infectious diseases. Their role in the pathogenesis of malnutrition and growth retardation is readily apparent from the wealth of clinical and epidemiological evidence presented in past chapters and from the statistical evidence here presented. Stepwise regression analysis with many variables summarizing infectious experiences showed that they account for a large and significant part of the variance of physical growth (Mata 1978: 318).

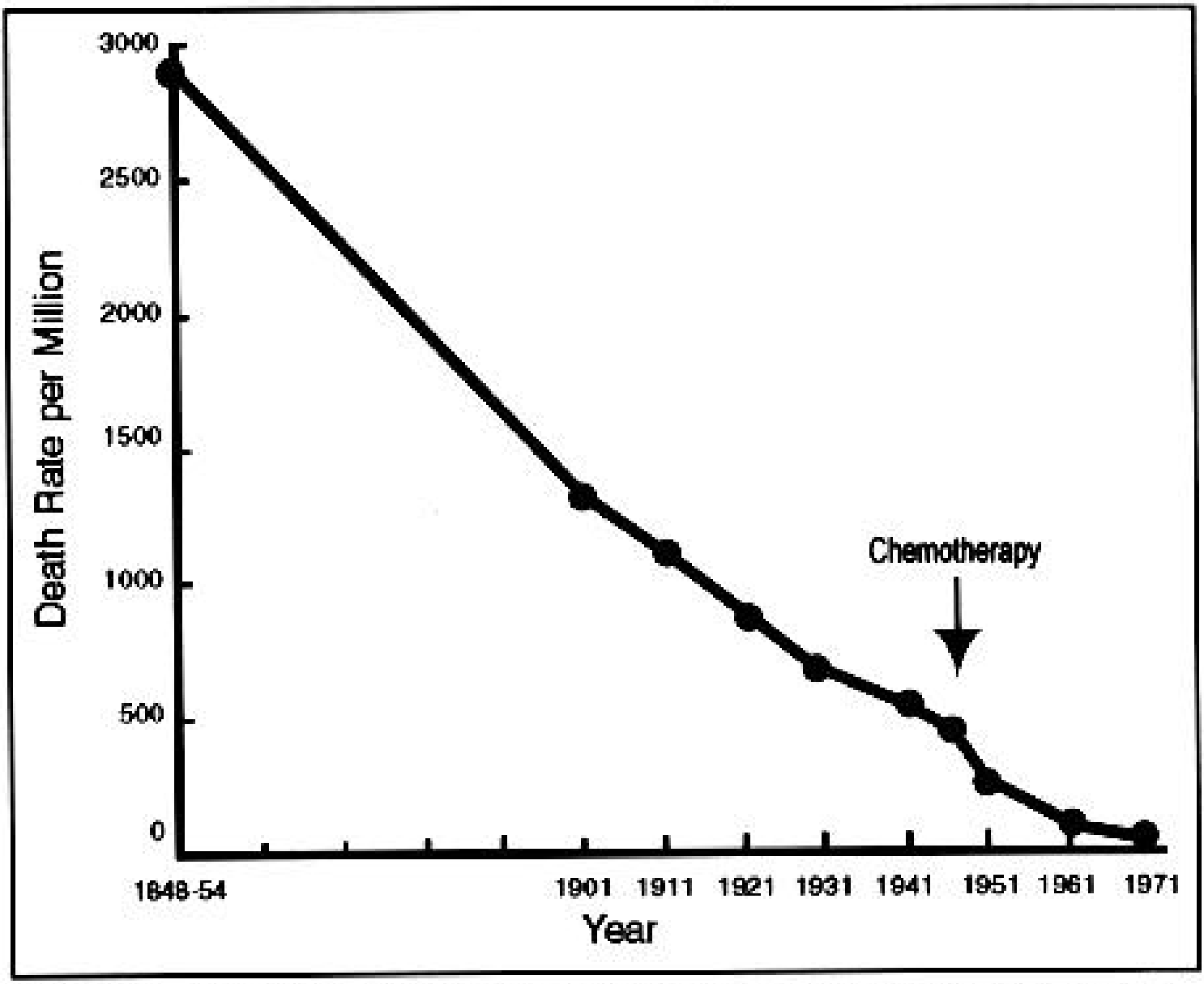

Figure 1. Respiratory tuberculosis: death rates standardized to the age-sex distribution of the 1901 population. Source: McKeown et al. (1975).

A second problem with the dietary explanation for the United States is that it was already a very well-fed country by 1900. In fact, dietary reconstructions from direct inquiries suggest that the average daily caloric consumption per adult equivalent was about 3700, higher than today (Preston and Haines 1991).

A third problem with the explanation is that it is inconsistent with international evidence. Figure 2 shows that the relationship between life expectancy and income per capita (in constant dollars) has shifted dramatically in the course of the 20th century (Preston 1975). Only about 20% of the increase in life expectancy between the 1930s and the 1960s is attributable to movements along the curve—to gains in income and the attendant improvements in diet—while 80% is attributable to exogenous shifts in the curve.

So if it wasn't Big Medicine and it wasn't diet, what was it? I'll briefly summarize a book and several articles that I've written on this subject with several collaborators (Preston and Haines 1991; Ewbank and Preston 1990; Condran and Preston 1994). These focus on the first half of the century, when the gains in life expectancy were fastest. I believe that the essential element in the gains was an enormous scientific breakthrough—the germ theory of disease. This theory was empirically validated in the 1880s and was beginning to displace the misguided miasma theories by the turn of the century. While the new theory led to few practical drugs, it led to an entirely new approach to preventative medicine, practiced both by departments of public health and by individuals. In the 1880s and 1890s, the main preventative measure practiced by individuals was the building of "stench traps" to keep miasma from entering the home. The main initiatives of public health officials were, quite sensibly, improvements in water supply and sewage disposal. But the criterion for success was sight and taste and odor, rather than bacteria counts.

All this changed rapidly. Enlightened public health officials were quick to recognize how the germ theory should guide their practice. Furthermore, by the time of the first White House Conference on Infant Mortality, held in 1909, they realized that rapid advances in longevity required that public officials go beyond their normal domain of public works and attempt to change the personal health practices of individuals. The germ theory provided a number of powerful weapons for doing so. These included boiling bottles and milk, washing hands, protecting food from flies, isolating sick children, and ventilating rooms. Public health officials launched massive campaigns to encourage these practices. In New York City, milk depots were established with the ostensible purpose of distributing milk to indigent mothers but with the real purpose, according to the director, of instructing mothers in hygienic practices. The New York City Department of Health produced one of the nation's first motion pictures, entitled *The Fly Pest*. At the national level, the new Children's Bureau adopted a primary focus on child health. Its pamphlet called *Infant Care* became the largest selling volume in the history of the Government Printing Office, with some 12 million copies sold by 1940. By the 1920s, the bureau was receiving and answering over 100,000 letters a year from parents seeking child care advice.

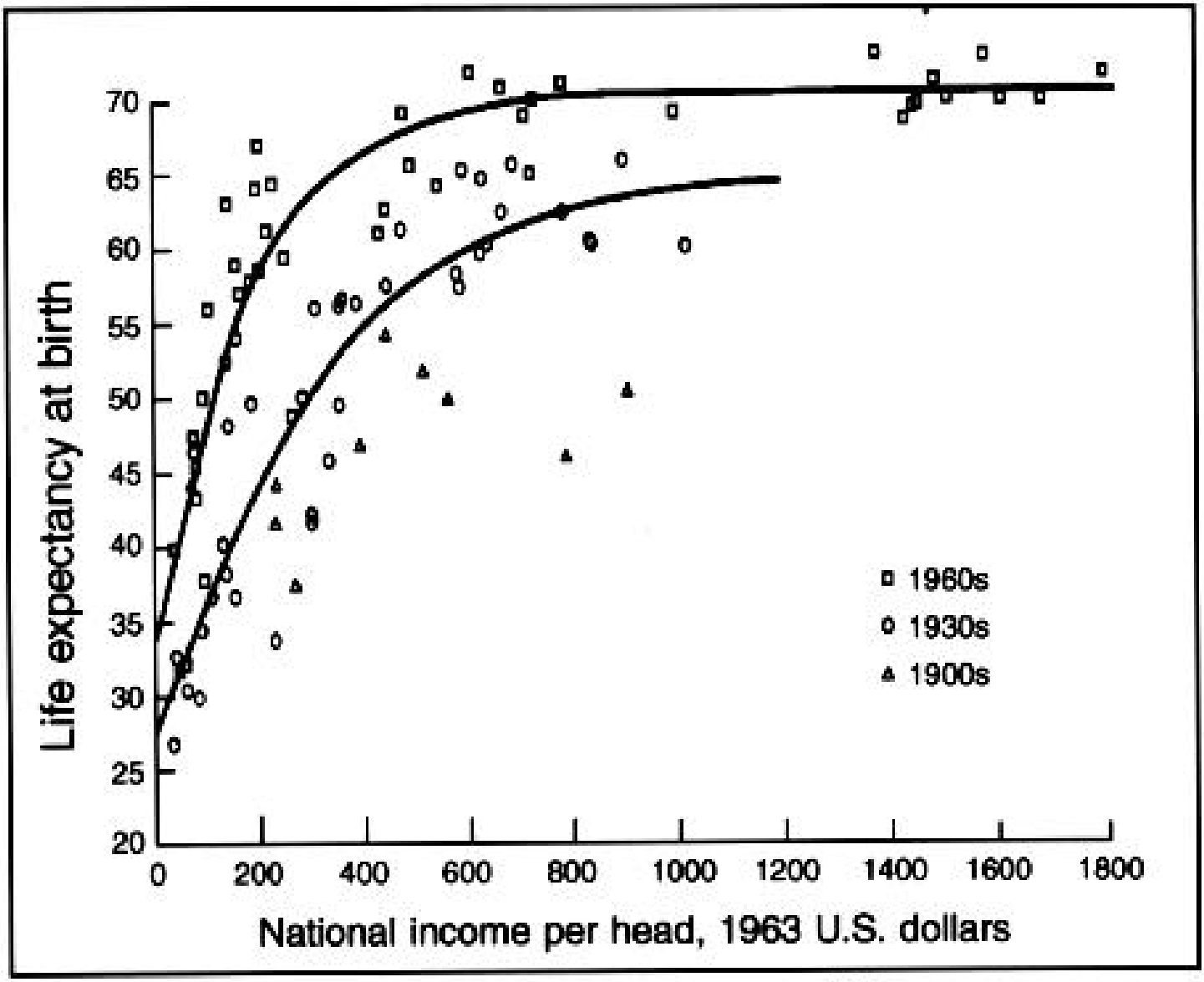

Figure 2 Scatter-diagram of relations between life expectancy at birth and national income per head for nations in the 1900s, 1930s, and 1960s. Source: Preston (1975).

One place to look for evidence that personal health care practices were changing in a healthy direction is the distribution of child mortality by social class. My colleagues and I have spent a great deal of effort developing this evidence, including the construction of large samples from the U.S. Censuses of 1900 and 1910. These censuses asked questions on the number of children each woman had borne and the number who were still living at the time of the census. These questions permit a rather fine-grained picture of child mortality at the time. Other informal evidence suggests that the new hygienic practices were being adopted most vigorously among the professional classes. If so, and if they were effective, one should see a widening of social class differences during this period.

Table 1 shows that this is exactly what was happening. At the turn of the century, the children of physicians had mortality that was scarcely better than that for the average child, indicating fairly clearly that physicians had few weapons at their disposal to advance survival. By 1924, the mortality of physicians' children was 35% below the national average. Children of teachers advanced as rapidly, and all professionals made great strides during the period.

Table 1. Indexes of Relative Child Mortality by Selected Father's Occupations: United States, 1895-1924

Occupation	1895[1]	1905[2]	1922-24[3]
Professionals	95	92	70
Physicians, Dentists, Veterinarians	100	92	65
Teachers	100	104	61
Farmers	86	90	91
Farm Laborers	111	117	117
Manufacturing			
Managers	81	95	71
Foremen	100	108	91
Laborers	136	136	126
All Children	100	100	100

Source:
[1]Public Use Sample of the 1900 U.S. Censuses of Population.
[2]Public Use Sample of the 1910 U.S. Censuses of Population.
[3]U.S. Bureau of Census. 1926. *Birth, Stillbirth, and Infant Mortality Statistics for the Birth Registration Area of the United States, 1924.* Washington, DC: Government Printing Office.

So this explanation emphasizes a fundamental scientific advance, the germ theory, as implemented by public officials and, perhaps more importantly, aggressively disseminated by them to an extremely eager audience. Public health officials were heroes. Shortly after his death in 1923, Cornell University students and faculty proclaimed Herman Biggs, former Public Health Commissioner of New York City and then of New York State, their most outstanding alumnus. It's hard to imagine a bureaucrat of any stripe, let alone a health commissioner, receiving such an accolade today.

The Period Since 1950

By midcentury, infectious diseases had been essentially brought under control, aided finally by a major medical advance, antibiotics, in the 1940s. The prominent diseases were now the chronic

diseases of adulthood, especially circulatory diseases and cancer. Did this mean an end to mortality improvements? Many experts thought so at the time, and all projections anticipated a slowdown in rates of improvement. Confirming the fears, adult male mortality in the United States did appear to stall in the 1950s and early 1960s. My dissertation in 1968 argued that the stall was temporary and reflected the rapid postwar uptake of cigarette smoking by men (Preston 1970). I was right.

In a powerful paper published in the *Journal of the American Statistical Association*, Lee and Carter (1992) show that the average pace of decline in age-specific death rates has been remarkably constant throughout the 20th century. The recession of infectious diseases did not mean an end to mortality decline. In particular, death rates from cardiovascular disease have fallen since the 1960s by approximately 50% on an age-adjusted basis (U.S. National Center for Health Statistics 1995, p. 97). Exactly how this happened is, I believe, more mysterious than the gains in longevity during the first half-century. The spread of drugs to control high blood pressure is certainly part of the story. So may be advances in cardiovascular surgery and in the emergency treatment of heart attacks. Big Medicine is quite possibly playing a larger role during this period. But in one important respect the decline in cardiovascular disease is repeating the pattern of the change in child mortality earlier in the century.

Figure 3 is drawn from a paper by Feldman et al. (1989), who investigate how mortality declines at older ages between 1960 and 1980 were distributed by educational attainment. As indicated in the figure, the mortality declines, especially for males, have been largest among better educated people. Irma Elo and I have replicated this result on a larger and more recent data set using Gini coefficients and slopes and other measuring devices (Preston and Elo 1995).

We are unquestionably in another period of widening class differentials in mortality, especially for men. As in the earlier period, it seems likely that changes in personal health behaviors are implicated in this pattern. Most obviously, there has been a huge reduction in smoking by better educated people. When the Surgeon General's report on the health hazards of smoking appeared in 1964, there was basically no difference in the smoking behavior of different educational groups. By 1987, only 17% of male college graduates smoked, compared to 41% of high school dropouts (U.S. National Center for Health Statistics, 1989). Smoking is not the only health behavior that differentiates the groups. Epidemiologic investigations suggest that physical inactivity, animal fat consumption, obesity, and nearly all other damaging behaviors are more prominent among persons with less schooling (e.g., Shea et al. 1991; Winkleby et al. 1992). The one differential in mortality that has begun to narrow—for the first time in the 20th century—is that between males and females, probably because males have abandoned smoking at a faster clip than females.

Figure 3 is also important for what it doesn't show. A revolutionary change in access of older people to Big Medicine—Medicare—was implemented between the two observations. Above age 65, Medicare should have had a much bigger impact on the medical opportunities of the poor than of the middle class. But the mortality differentials clearly grew wider instead of narrower. Elo and I concluded that on all measures the inequality trends were more adverse for persons aged 65+

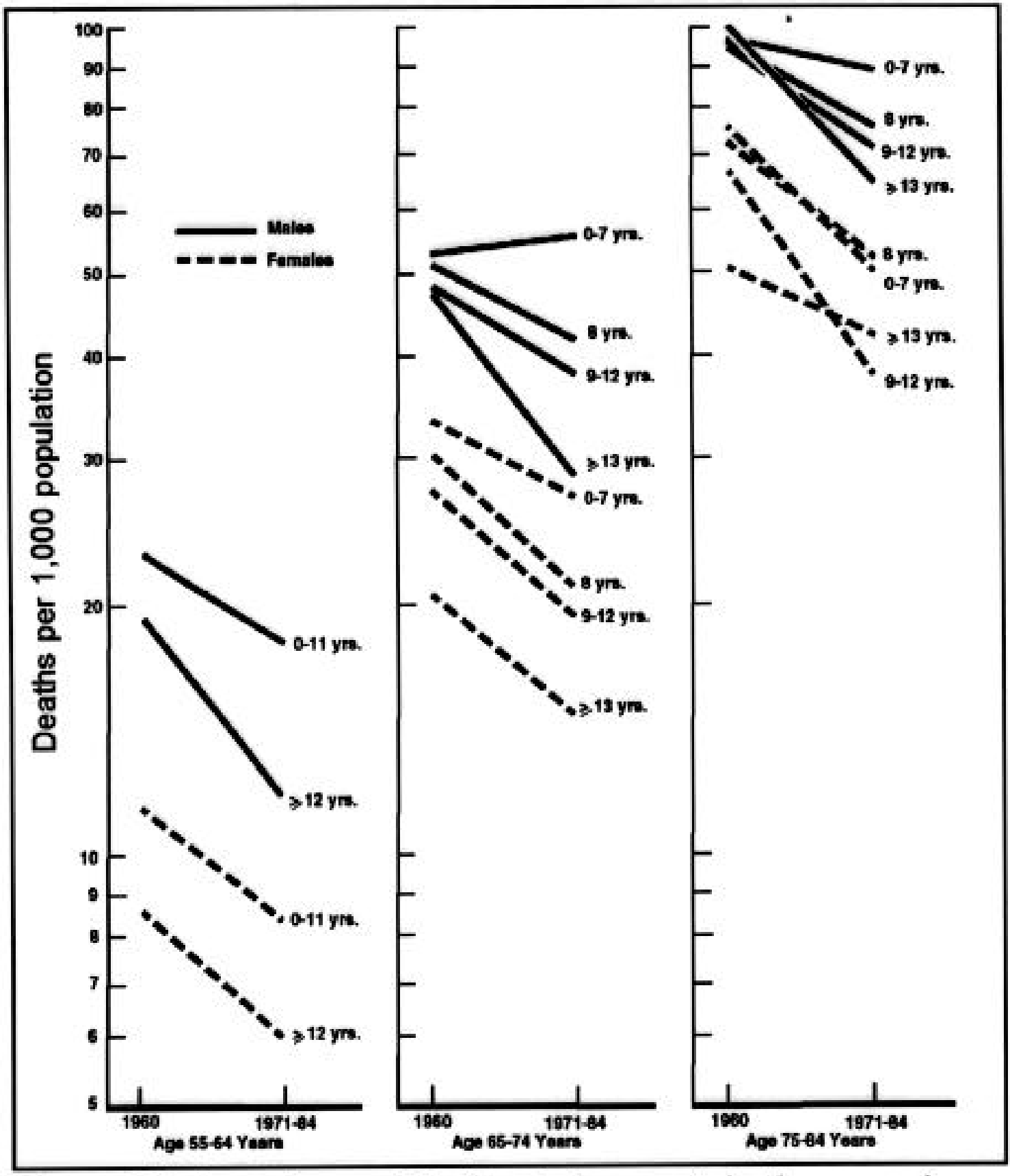

Figure 3 Estimated annual death rates by age at death, sex, and educational attainment among white persons aged 55-84 years, United States, 1960 and 1971-84. Source: Feldman et al. (1989).

than for persons aged 25-64. Medicare did not leave a visible mark on these differences, nor on mortality trends by age. This experience repeats the postwar British experience. After the National Health Service was introduced in 1948, social class differences in mortality widened (Pamuk 1985).

These results clearly bear upon the debate over health care reform. My own guess is that extending Medicare-like entitlements to the entire population would have very minor effects on mortality levels. It probably wouldn't keep many people alive for much longer. There are other outcomes of interest, of course, and there may be many other reasons to move in this direction. But one important outcome measure suggests that unequal access to Big Medicine has not been a critical factor in the health of the American population.

The Future of Longevity

Every silver lining has a cloud. The great longevity triumphs of the 20th century will, if extended into the 21st century, pose a major additional threat to the fiscal viability of the Social Security system. Simulations done by the Social Security Administration and presented in the 1995 Trustees Report show that the 75-year actuarial balance of the Social Security fund is more sensitive to the future of mortality than it is to uncertainty in any other series: fertility, immigration, real wage growth, inflation, real interest rates, and disability incidence and termination rates. If mortality declines rapidly rather than slowly, the deficit grows by 1.5% of total taxable payroll over the 75-year period. The sensitivity is all the more noteworthy because the Social Security Administration has a narrower band of uncertainty in its mortality forecasts than does the U.S. Census Bureau, the other federal agency making population projections (Preston 1993).

In their intermediate projection series, the Social Security Administration assumes that age-sex-adjusted death rates will fall by a total of 35% in the 75-year period starting in 1994. By historical standards, this is a very slow decline. In the first 75 years of the century, the age-sex-adjusted death rate fell by 59%, which amounts to *two* reductions of 35%; in the last 75 years, it also fell by 59% (compiled from Social Security Administration 1992, p. 9). The most recent reduction of 35% in death rates required only 38 years, half of the time allotted by the Social Security Administration. Lee and Carter's (1992) stochastic projections of U.S. life expectancy, based on the regularities they observed throughout the 20th century, show that the *intermediate* Social Security projection for the year 2065 of 80.5 years lies below their 95% confidence interval. Lee and Carter's forecast for 2065 is a life expectancy of 86.1 years. The Social Security intermediate projection of 80.5 years in 2065 is only one year above the life expectancy that Japan has already achieved. Japan's life expectancy at birth in 1994 was identifical for both males and females to that projected for the United States in 2050.

I served on a Social Security Advisory Council Task Force on Assumptions and Methods that completed its report in late 1995 (Technical Panel 1995). We asked the Social Security actuaries to justify the projection of a sharp slowdown in rates of mortality improvement. Their argument was that the successes of the past were unrepeatable; the great gains had already been made. In earlier years, the actuaries would refer to expert opinion that they had elicited, but this it no longer done. It's an in-house consensus.

And it may prove to be correct. But I am skeptical. The factors that have been at work throughout this century will still be at work in the next. Even with no additional advances in knowledge about disease processes, there is enormous scope for changes in risk factor distributions, especially in personal health behaviors, to reduce mortality. In a series of papers, Ken Manton has attempted to predict what life expectancy would be if people behaved in the healthiest manner. These efforts rely on data from the Framingham study, from the Alameda county HMO, from Mormon high priests, Seventh Day Adventists, and Harvard alumni. Using

either simple or complex procedures, he typically finds life expectancies in the 90s or even low 100s for both men and women if optimal lifestyles were adopted (e.g., Manton et al. 1991). The adoption of healthier lifestyles will be facilitated by improvements in educational distributions at older ages; bear in mind that about two-thirds of the population aged 85-89 in 1990 did not complete high school (Preston 1993).

Later-born cohorts have also had healthier childhoods and subsequent life histories. Among other things, they've had less exposure to the infections that are important risk factors in later development of cancers of the stomach, liver, and uterus, of ulcers, cirrhosis of the liver, and rheumatic heart disease.

The medical research establishment is extremely well-fortified and enjoys enormous popular support; witness the recent increases in funding for the National Institutes of Health. And its products find a very receptive audience, so much so that nearly every issue of the *New England Journal of Medicine* is an occasion for a report in the national news. The demand for these products seems certain to grow as the baby boomers start to brush up against chronic diseases. I suspect that we are only scratching the surface of what bioengineering and gene therapy will be able to do in the next 75 years.

Adaptations

How should the Social Security system react to a surge of unexpected arrivals at the drinking fountain? My own view is that a tax increase would be a mistake. The Social Security tax is obviously highly regressive. Over a representative lifetime, its regressivity is compensated by a very progressive benefit structure. But it seems to me that we're beyond the point where anyone can guarantee a close connection between an individual's contributions and his or her eventual benefits. In a period when the income distribution is already pulling apart, making the tax structure more regressive and promising eventual compensation would add insult to injury.

A more appealing adaptation would be to raise the age of entitlement for benefits. Using 1987 data, it appears that a one-year gain in life expectancy at birth would require about a 3.5% reduction in benefit schedules or an equivalent increase in taxes (Lee and Tuljapurkar 1996). I estimate that annual balance could be restored by raising the age at retirement by roughly one-half year. So if life expectancy by 2050 grew by 5 more years than Social Security projects, which is about the rate of disagreement that we are discussing, then the ages of early and normal retirement would have to be raised by about two and one-half years. Such a change would be mildly regressive, since death rates are higher for low earners and they are less likely to survive from the previous ages of entitlement to the new ages. So some rejiggering of benefits may be necessary in the interests of equity.

I suspect that the logic of linking a change in retirement age to changes in life expectancy would be understandable to most participants, certainly more so than discussions of age structure and

generational equity. It makes clear on an individual level how progress sometimes comes at a cost, probably a minor one in most people's eyes relative to the tremendous gains in longevity that they have enjoyed. The link is sometimes being made already in the popular press, although not in statements from the Social Security Administration. Out in front on this issue is Sweden, which has explicitly indexed its retirement benefits to changes in life expectancy.

The linkage has a certain appealing symmetry. Social Security insures individuals against the risk of living too long. Yet the greatest risk for the system itself is that too many individuals will succeed in doing so. To gain control over the major source of uncertainty in the system, it makes sense to share the risk with the beneficiaries.

References

Condran, G. and S. Preston. 1994. "Child Mortality Differences, Personal Health Care Practices, and Medical Technology." In Lincoln C. Chen, Arthur Kleinman, and Norma Ware, eds. *Health and Social Change in International Perspective*. Cambridge: Harvard University Press.

Ewbank, D. and S. Preston. 1990. "Personal Health Behavior and the Decline in Infant and Child Mortality: The United States, 1900-30." In J. Caldwell, ed. *What We Know About Health Transition.* Canberra: Australia National University.

Feldman, J.J., D. Makuc, J. Kleinman, and J. Cornoni-Huntley. 1989. "National Trends in Educational Differentials in Mortality." *American Journal of Epidemiology*, Vol. 129: 919-933.

Fogel, Robert W. 1994. "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy." *American Economic Review*, Vol. 84: 369-395.

Lee, Ronald D. and Lawrence Carter. 1992. "Modeling and Forecasting the Time Series of U.S. Mortality." *Journal of the American Statistical Association*, Vol. 87: 659-671.

Lee, Ronald and Shripad Tuljapurkar. 1996. "Death and Taxes: How Longer Life Will Affect Social Security." Unpublished manuscript, Department of Demography, university of California, Berkeley.

Manton, Kenneth G., Eric Stallard, and H. Dennis Tolley. 1991. "Limits to Human Life Expectancy: Evidence, Prospects, and Implications."*Population and Development Review*, Vol. 17:603-638.

Mata, Leonardo J. 1978. *The Children of Santa Maria Cauque: A Prospective Field Study of Health and Growth.* Cambridge: MIT Press.

McKeown, Thomas. 1976. *The Modern Rise of Population.* New York: Academic Press.

McKeown, Thomas, R.G. Record, and R.D. Turner. 1975. "An Interpretation of the Decline of Mortality in England and Wales During the Twentieth Century." *Population Studies*, Vol. 29:391-422.

Pamuk, Elsie. 1985. "Social Class Inequality in Mortality from 1921 to 1972 in England and Wales." *Population Studies* 39(1):17-31.

Preston, Samuel H. 1993. "Demographic Change in the United States, 1970-2050." In A.M. Rappaport and Sylvester Scheiber, ed. *Demography and Retirement: The Twenty-First Century*. Westport, CT: Praeger Pubs.

_____. 1975. "The Changing Relation Between Mortality and Level of Economic Development." *Population Studies*, Vol. 29(2):231-248.

_____. 1970. *Older Male Mortality and Cigarette Smoking*. Institute of International Studies, University of California, Berkeley, Population Monograph No. 7.

Preston, S.H. and I. Elo. 1995. "Are Educational Differentials in Adult Mortality Increasing in the United States?" *Journal of Aging and Health*. Vol. 7(4):476-96.

Preston, S., D. Ewbank, and M. Hereward. 1994. "Child Mortality Differences by Ethnicity and Race in the United States, 1900-1910." In S. Watkins, ed. *Beyond Ellis Island.* New York: The Russell Sage Foundation.

Preston, S.H. and M. Haines. 1991. *Fatal Years: Child Mortality in Late Nineteenth Century America.* National Bureau of Economic Research Series on Long-Term Factors in Economic Development. Princeton: Princeton University Press.

Shea, S., A.D. Stein, C.E. Basch, R. Lantigua, C. Maylahn, D.S. Strogatz, and L. Novick. 1991. "Independent Associations of Educational Attainment and Ethnicity with Behavioral Risk Factors for Cardiovascular Disease." *American Journal of Epidemiology.* Vol. 134:567-582.

Simon, Julian.1995. *The State of Humanity*. Cambridge, MA: Blackwell.

Social Security Administration. 1992. *Social Security Area Population Projections 1991.* SSA Pub. No. 11-11553. Baltimore: Social Security Administration.

Technical Panel on Assumptions and Methods, 1994-95 Advisory Council on Social Security. 1995. *Final Report.* Unpublished manuscript.

Trustees, Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds. 1995. *Annual Report.* Washington, DC: U.S. Government Printing Office.

U.S. National Center for Health Statistics. 1989. *Smoking and Other Tobacco Use: United States, 1987.* Vital and Health Statistics Series 10, No. 169. Rockville, Md: National Center for Health Statistics.

_____. 1995. *Health: United States 1994.* Hyattsville, Md: National Center for Health Statistics.

White, Kevin and Samuel H. Preston. 1996. "How Many Americans Are Alive Because of 20th Century Health Advances?" Unpublished manuscript, Population Studies Center, University of Pennsylvania.

Winkleby, M.A., D.E. Jatulis, E. Frank, and S.P. Fortmann. 1992. "Socioeconomic Status and Health: How Education, Income, and Occupation Contribute to Risk Factors for Cardiovascular Disease." *American Journal of Public Health.* Vol. 82:816-820.