Is the Pace of Japanese Mortality Decline Converging Toward International Trends?

John R. Wilmoth

Population and Development Review, Volume 24, Issue 3 (Sep., 1998), 593-600.

Stable URL:
http://links.jstor.org/sici?sici=0098-7921%28199809%2924%3A3%3C593%3AITPOJM%3E2.0.CO%3B2-H

Is the Pace of Japanese Mortality Decline Converging Toward International Trends?

JOHN R. WILMOTH

FROM THE END of World War II until recently, the pace and magnitude of the Japanese mortality decline were unprecedented in human history. Records in the years immediately after the war are incomplete, but an estimate of Japanese life expectancy at birth in 1947 is around 52 years (Nanjo and Kobayashi 1985). Life expectancy at that time was about 67–69 years in North America and the less war-ravaged parts of Western Europe. By 1951 Japan's postwar recovery had begun, its statistical system had improved, and life expectancy had risen to about 61 years.[1]

From 1951 until 1980, life expectancy rose at an average rate of about five years per decade. As a result, male and female Japanese life expectancies surpassed those of the traditional world leaders, including the Scandinavian countries, just prior to 1980.[2] By 1996 female and male life expectancies in Japan were 83.6 and 77.0, respectively, ahead of all other large national populations. Japan's closest competitors are now, for women, France and Switzerland at 82 years and, for men, Sweden and Iceland at 76 and 77 years, respectively (Population Reference Bureau 1997).

Japan's rapid rise to the top in matters of health and longevity offers an unusual opportunity for reflection on the nature and especially the speed of historical mortality change. Let us consider a few simple questions: Can the pace of the postwar decline in Japanese mortality continue, or will future gains come at a slower pace? Can we predict what the future rate of improvement will be? Without pretending to foresee the future, in this brief note I recapitulate an earlier argument, provide some updated supporting evidence for that argument, and suggest some ideas for further analyses of these questions.

Why expect convergence?

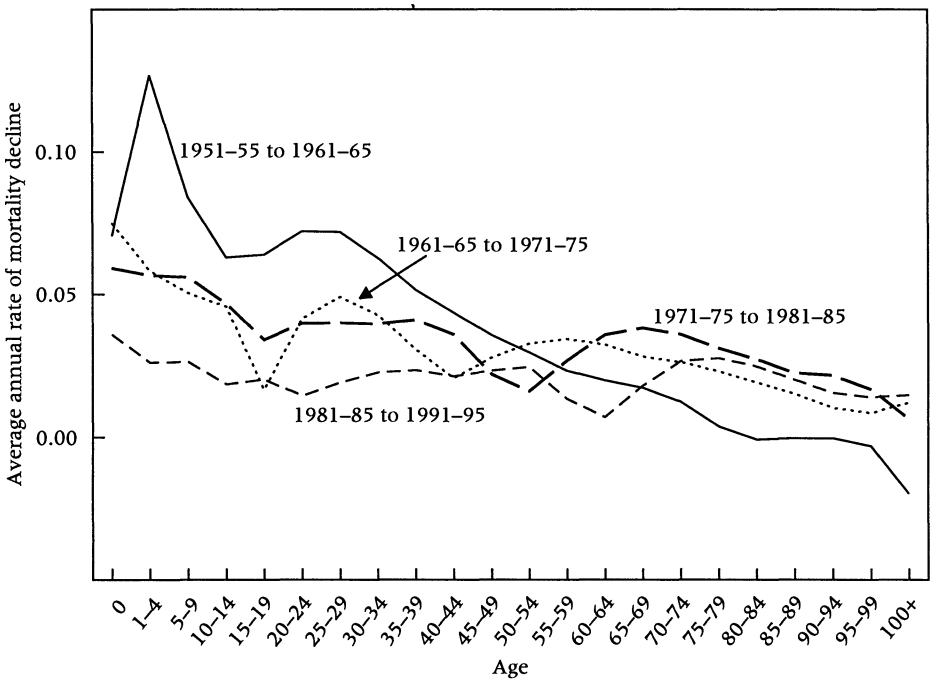
A major part of the Japanese mortality decline during the past 50 years consisted of catching up with the traditional leaders in this area. Japan came out of World War II with more national experience in matters of public health and modern medicine than any country outside of Europe and its diaspora. In fact, relative to its level of wealth and development in the prewar period, Japan had been notably successful in improving the physical wellbeing of its population (Johansson and Mosk 1987). Following the war, Japan continued its tradition of borrowing generously from Western science and technology and of successfully adapting these to local conditions. The rise of life expectancy in postwar Japan was one aspect of its emergence as an economic superpower during this period.

Now, however, Japan has entered uncharted territory in matters of health and longevity. Today, other countries look to the Japanese for the secrets of their success, and it is the Japanese who must push back the frontier if they wish to remain at the head of the pack. As a late starter in the process of mortality decline, Japan was able to make rapid progress by borrowing from the experience and technology of other countries, but this advantage necessarily diminished as the country reached the mortality level of the early starters. Thus, it is intuitively plausible that the pace of Japanese mortality decline should have slowed in recent decades to a level that resembles the long-term pace of decline experienced by earlier world leaders. We may refer to this process as "convergence."

For sake of argument, let us define the "avant-garde country" at any given point in history as that country whose overall level of mortality equals the minimum achieved at that time by any national population.[3] For nearly two decades, then, Japan has been the avant-garde country. In earlier periods, it was Sweden, Norway, the Netherlands, and so forth. Thus, to rephrase our earlier questions: Now that Japan has become the avant-garde country, should we base our expectation of its future mortality trends on past Japanese experience or on the experience of previous avant-garde countries? Intuition suggests that future trends in Japanese mortality should come to resemble those of the long-time leaders in this field. A comparison of the mortality histories of Japan and Sweden confirms this expectation.

Figure 1, which presents age profiles of the average annual rate of mortality decline in Japan for four time periods since 1951–55, shows that over this period the pace of Japanese mortality decline at ages below 50 years has fallen substantially. At ages above 50 years, the pace of change has been steadier.[4] Figure 2, on the other hand, demonstrates that the rate of mortality decline in Sweden has been relatively stable across the age range over this period. Taken together, these figures illustrate the unusual

FIGURE 1 Age pattern of mortality decline during four time periods: Japan, sexes combined, 1951–95



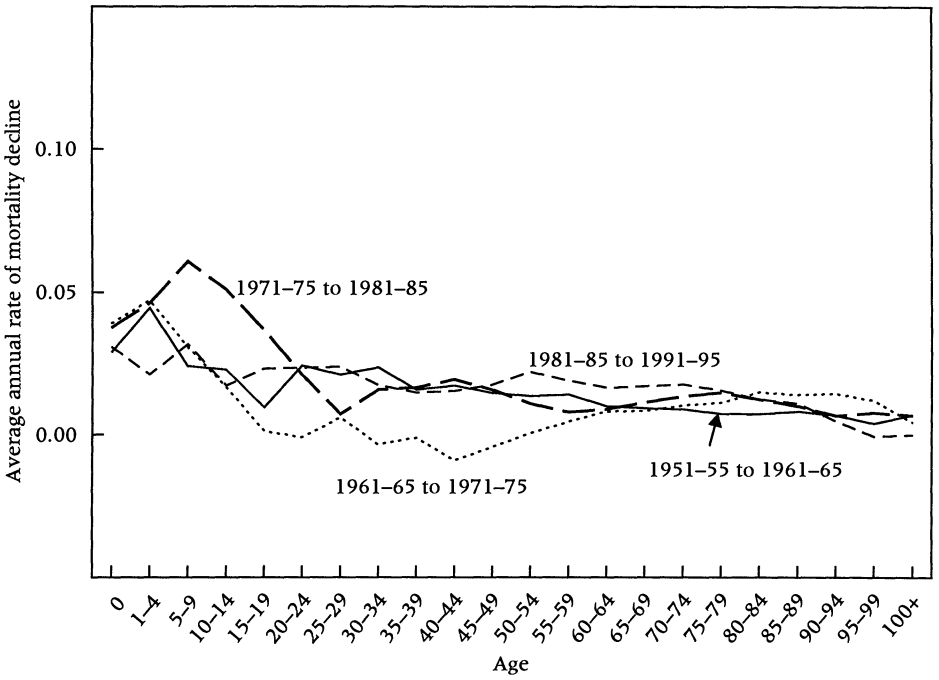
NOTE: The average annual rate of mortality decline, ρ, for a given age group and time period is calculated as follows. If M_1 and M_2 are observed mortality rates (for some age group) in the earlier and later time periods, respectively, then $\rho = -\frac{1}{T}\ln\left[\frac{M_2}{M_1}\right]$, where T is the number of years between the midpoints of the two time intervals. On inaccuracies of reported age among the elderly see note 4.
SOURCE: Berkeley Mortality Database, http://demog.berkeley.edu/wilmoth/mortality.

nature of the Japanese mortality decline. Whereas the rise of life expectancy in most other developed countries can be separated into an early phase characterized by very rapid reductions in infectious diseases at younger ages (Omran 1971) and a more recent phase characterized by an accelerating decline in death rates among the elderly (Kannisto 1994; Kannisto et al. 1994), these two sets of changes occurred almost simultaneously in Japan (Horiuchi and Wilmoth 1998). The temporal proximity of these two health transitions produced the unprecedented, yet unsustainable, pace of mortality decline in Japan during the early postwar period.

Prediction and confirmation

In a project begun in 1992, presented at a scientific conference in 1993, and published in 1996, I made a series of mortality forecasts for Japan based on four sets of assumptions (Wilmoth 1996). Here, let us consider only

FIGURE 2 Age pattern of mortality decline during four time periods: Sweden, sexes combined, 1951–95



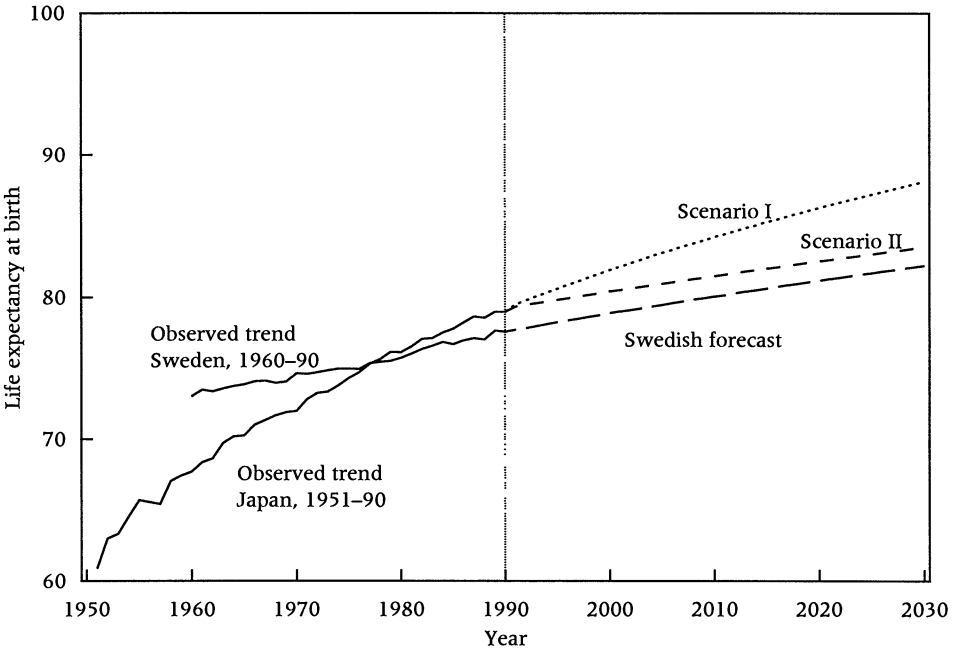
NOTE: See note to Figure 1.
SOURCE: Berkeley Mortality Database, http://demog.berkeley.edu/wilmoth/mortality.

two of the four scenarios explored in the previous work. The first scenario was a simple extrapolation of Japanese trends from 1951 to 1990, based on a technique proposed by Lee and Carter (1992). In other words, the first scenario contained the implicit assumption that the pace of Japanese mortality decline during 1951–90 would continue in future years.

The second scenario was based on the idea that Japanese mortality trends should be converging toward those of the avant-garde country. Sweden was used as a proxy for the avant-garde country, and the trend of Japanese mortality decline was forced immediately (after 1990) onto the extrapolated Swedish trend. In this scenario Japan retains its advantage over Sweden as of 1990, so that forecasts of life expectancy for the two countries rise nearly in parallel.[5] Forecasts of Japanese life expectancy at birth for the two scenarios are shown in Figure 3, along with actual and extrapolated trends for Sweden.[6]

What has happened since 1990? Mortality data for Japan are now available through 1996. Figure 4 again compares the first and second scenario-based forecasts for Japan. The additional lines in this graph show confidence intervals, computed by the Lee–Carter method, for the first sce-

FIGURE 3 Life expectancy trends and forecasts (baseline = 1990): Japan and Sweden, sexes combined, 1951–2030



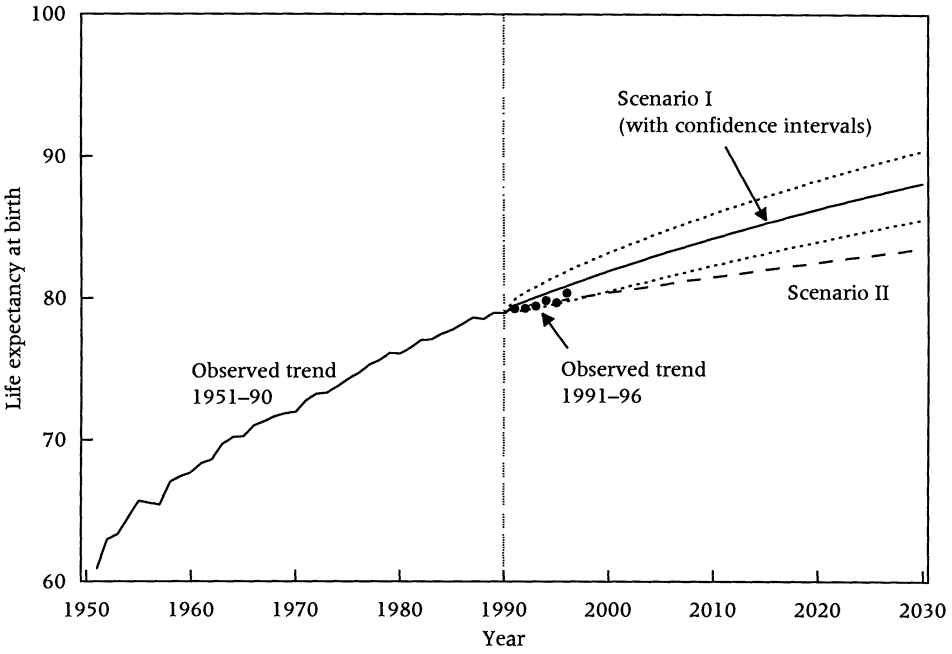
NOTE: Scenario I for Japan and the forecast for Sweden are synthetic extrapolations using the Lee–Carter method with data during 1951–90 for Japan and 1960–90 for Sweden. Scenario II forces the Japanese trend after 1990 onto the Swedish trend (see note 5).
SOURCE: Wilmoth (1996).

nario. As noted in an earlier publication, the prediction for the second scenario falls outside the confidence intervals for the first scenario after about nine years (Wilmoth 1996: 275). Now, with six more years of data, it is notable that the observed trend has been closer to the second scenario, which was based on the notion of an avant-garde country, than to a simple extrapolation of Japanese postwar trends prior to 1990. Although observed life expectancies for 1991–96 are still within the confidence bands for the first scenario, they are consistently below the trend line for that extrapolation. While firm conclusions are not possible based on only six data points, the trend in Japanese life expectancy since 1990 seems to be following the prediction of the second scenario quite closely. Thus, the pace of Japanese mortality decline has not only slowed in recent decades but has also been converging with international trends.

Ideas for further analysis

It is debatable whether the results described here are truly provocative, or whether they merely confirm our expectations based on common sense. Perhaps no one would in fact have suggested that social and biological

FIGURE 4 Life expectancy trends and forecasts (baseline = 1990): Japan, sexes combined, 1951–2030



NOTE: Both forecasts were prepared using data through 1990 (see note to Figure 3).
SOURCES: Wilmoth (1996); Berkeley Mortality Database, http://demog.berkeley.edu/wilmoth/mortality.

progress in Japan could maintain its exceptionally rapid pace once the country became a world leader in many domains. In any event, it is reassuring to observe that reality accords well with our expectations.

A deeper aspect of these observations may be the notion of a hypothetical avant-garde country, which defines the limits of progress along one dimension (average longevity) at any point in time. The national avant-garde of longevity was found in Europe (and perhaps occasionally in North America) over many decades (perhaps centuries) prior to 1980. Its migration to Japan and thus East Asia was a momentous event in human history, since life expectancy at birth is perhaps the best single indicator of the overall wellbeing of a population.

The notion of an avant-garde country has importance as well for the theory of mortality forecasting. Whereas the rate of progress in a single country may vary and exhibit sharp changes at particular moments in history, trends for the avant-garde country have been steadier. In preparing mortality forecasts for a given country, the extrapolated trend for the avant-garde country should form the basis for a long-term "high" scenario in terms of life expectancy. In other words, the most optimistic expectation for any country should be based on a projection of trends for the avant-garde country.

For these and other purposes, a useful empirical investigation would be to trace out in detail the historical characteristics of the avant-garde country. The geographic movement of the country bearing this designation would provide a uniquely synthetic view of the history of social and technological progress. Its temporal dimension would perhaps support the contention that the pace of change at the forefront of this progress has been remarkably steady over a period of at least one and perhaps two or more centuries. It would also be instructive to reflect upon the nature of those changing features of the mortality regime associated with the emergence of new world leaders at different moments in history, as was done by Yanagishita and Guralnik (1988) in their study of how and why Japanese mortality fell below Swedish levels. The final piece of this puzzle would be a comprehensive analysis of the causal relationships linking trends in longevity to broader social and technological changes at the time of these historic shifts.

Notes

This research was supported by a grant from the National Institute on Aging (R01-AG11552). The author acknowledges the helpful suggestions of Shiro Horiuchi and Ronald Lee on a previous draft. Please send comments via email to jrw@demog.berkeley.edu.

1 Detailed mortality data for Japan during 1951–96 are available through the Berkeley Mortality Database, located at http://demog.berkeley.edu/wilmoth/mortality.

2 Male life expectancy in Japan surpassed Swedish levels in 1977. Japanese women first had a higher life expectancy than their Swedish counterparts in 1979, fell below Swedish levels in 1980, then moved and stayed ahead beginning in 1981.

3 As used here, the overall level of mortality refers to life expectancy at birth. A more complicated notion of an avant-garde country might be based on minimum levels of age- and/or cause-specific mortality.

4 Inaccuracies of reported age among the elderly are known to affect adversely the quality of Japanese vital data until perhaps as late as 1970 (Wilmoth and Lundström 1996). It is likely, therefore, that the apparent increase in mortality rates at advanced ages during the interval from 1951–55 through 1961–65, as shown in Figure 1, is an artifact of erroneous data.

5 By design, the extrapolated trends for Sweden and Scenario II for Japan are exactly parallel in terms of the time parameter of the Lee–Carter model, but only close to parallel in terms of life expectancy at birth. This parameter follows trends in the logarithm of mortality rates and is thus the basis for extrapolation in the Lee–Carter projection technique. Although the trend in Swedish death rates has been stable over a much longer period, the projections for Sweden used in Scenario II were based on data for 1960–90 only (because they were the only detailed mortality data for Sweden available to the author at the time the original projections were made).

6 In their previously published form, these forecasts were made separately for women and men. Here, forecasts based on identical methods are presented for both sexes combined, since results for the two sexes do not differ with regard to features now under discussion.

References

Horiuchi, Shiro and John R. Wilmoth. 1998. "Deceleration in the age pattern of mortality at older ages," *Demography* 35, no. 4 (in press).

Johansson, S. Ryan and Carl Mosk. 1987. "Exposure, resistance and life expectancy: Diseases and death during the economic development of Japan 1900–1960," *Population Studies* 41, no. 2: 207–235.

Kannisto, Väinö. 1994. *Development of Oldest-Old Mortality, 1950–1990: Evidence from 28 Developed Countries*. Odense, Denmark: Odense University Press.

Kannisto, Väinö, Jens Lauritsen, A. Roger Thatcher, and James W. Vaupel. 1994. "Reductions in mortality at advanced ages: Several decades of evidence from 27 countries," *Population and Development Review* 20, no. 4: 793–810.

Lee, Ronald D. and Larry R. Carter. 1992. "Modeling and forecasting U.S. mortality," *Journal of the American Statistical Association* 87, no. 419: 659–675.

Nanjo, Zenji, and Kazumasa Kobayashi. 1985. *Cohort Life Tables Based on Annual Life Tables for the Japanese Nationals Covering the Years 1891–1982*. Tokyo: NUPRI Research Paper Series, No. 23.

Omran, Abdel. 1971. "The epidemiological transition," *Milbank Memorial Fund Quarterly* 49, no. 4: 509–538.

Population Reference Bureau. 1997. *World Population Data Sheet*. Washington, DC.

Wilmoth, John R. 1996. "Mortality projections for Japan: A comparison of four methods," in Graziella Caselli and Alan D. Lopez (eds.), *Health and Mortality among Elderly Populations*. Oxford: Oxford University Press, pp. 266–287.

Wilmoth, John R. and Hans Lundström. 1996. "Extreme longevity in five countries: Presentation of trends with special attention to issues of data quality," *European Journal of Population* 12, no. 1: 63–93.

Yanagishita, Machiko, and Jack M. Guralnik. 1988. "Changing mortality patterns that led life expectancy in Japan to surpass Sweden's: 1972–1982," *Demography* 25, no. 4: 611–624.