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The Timing and Pace of Health Transitions around the World

JAMES C. RILEY

IN THE LAST half century demographers and historians have recovered a rich body of information about mortality levels and trends in the past in individual countries. In this exercise, I assemble data and estimates from some 700 sources to fashion a broad picture of regional and global life expectancy gains across time and space and examine some implications from that collective picture.¹ The countries I consider are those with populations in the year 2000 of at least 400,000.² Sources providing estimates of life expectancy at birth are listed by country in a bibliography provided separately.³

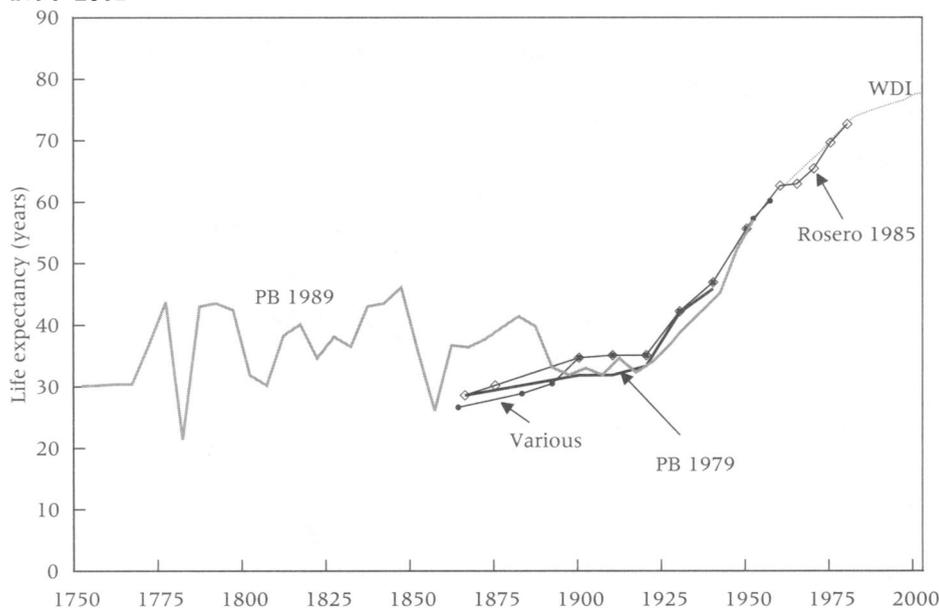
The term "health transition" describes the persistent gains in survival that have occurred in all countries and that are part of a long-run shift from low to high life expectancy. In individual countries the beginning of a health transition can typically be associated with a single decade or two successive decades marked by sustained gains in survival. For most countries and for the world as a whole the transition, once underway, continued into the 1980s with no more than temporary interruptions caused, for example, by wars, famines, or epidemics. Since the early 1980s there has been a trifurcation of experience. Most countries, even those with already high levels, have continued to add years of life expectancy, typically at a robust pace.⁴ In a second group, composed of countries in Eastern Europe and of countries in Asia that were formerly part of the Soviet Union, the transition from centrally planned to market-oriented economies has been accompanied by stagnation or decline in life expectancy, with females typically maintaining the prior level or gaining slightly but males losing ground. Tobacco use has slowed gains in the first group of countries and added to lost survival length in the second group. In a third group, mostly countries in central and southern Africa where HIV/AIDS has added sharply to mortality in early adulthood, life expectancy has regressed by as much as 19 years (in Zambia).

Appendix 1 gives a summary table showing a chronology of health transition beginning periods; the year used as the beginning point (in parentheses); the level of life expectancy at or near each beginning; life expectancy in 2000; the long-run pace of change from the beginning to 2000, reported as the average year-to-year increment; and the approximate or certain year when each country's life expectancy at birth equaled or passed 65 years.

Beginning periods

Scholars usually identify the beginning period of a health transition by nothing more sophisticated than a visual inspection of life expectancy estimates plotted over time. Usually what is evident is less the turning point than the subsequent period of sustained gains. Using such an approach, demographers and historians have often identified beginning periods for individual countries, although not always in complete agreement among themselves. Some problems remain, and those can be illustrated by reference to two examples: unresolved differences in interpretation and changes in population composition. Both the general recognition of beginning periods and the first problem—interpretations in disagreement—can be illustrated by Costa Rica's experience in Figure 1. Héctor Pérez Brignoli's (1989) reconstruction from the 1750s to the 1950s, based on crude death rates from population samples and

FIGURE 1 Life expectancy estimates for Costa Rica compared, 1750–2002



NOTE: PB = Pérez Brignoli; WDI = World Bank, *World Development Indicators 2004*.

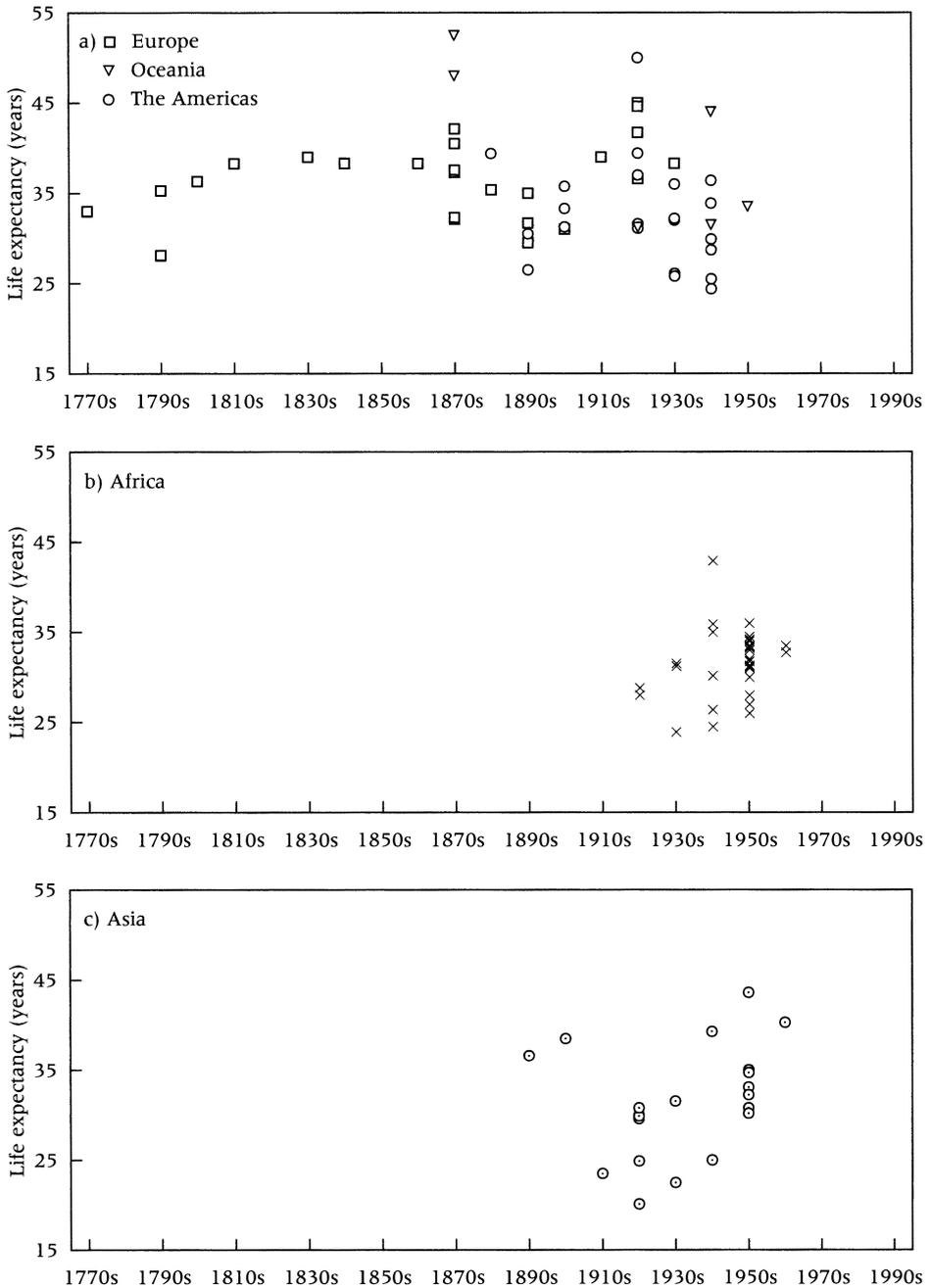
SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

certain assumptions about the age pattern of mortality, suggests that life expectancy in that period varied between 21.4 and 46.1 years, did not show a sustained pattern of improvement until the 1920s, and did not break out of the 21.4 to 46.1 range until the late 1940s. But other estimates, especially those made by Luis Rosero Bixby (Rosero and Caamaño 1984; Rosero 1985; and Mata and Rosero Bixby 1988), suggest that sustained gains began earlier, probably in the 1890s. The dispute centers on the level of life expectancy in the 1870s and 1880s, which Pérez Brignoli estimates to have been above 35 years but others place under 30. Such differences in interpretation are common in the literature, but it is usually the case that one set of estimates is supported by a superior body of evidence or a better method of reconstruction. For Costa Rica, however, a choice between these two interpretations requires additional evidence that is not yet available.

A second problem lies in features of population composition, which can be illustrated by a well-known case from European experience. In Western countries in the eighteenth century, death rates in all countries were significantly higher in urban than in rural areas (Davis 1973). Urbanization—a rising share of the population living in cities—began as early as the 1820s and is known to have created in England, France, Norway, and Belgium the appearance of stable mortality from roughly the 1820s to the 1870s, even though, at least in England, death rates actually declined in that period in rural and urban areas considered separately (Woods 1985; Szreter and Mooney 1998). Mortality appeared not to be improving, because the share of the population living in cities, where mortality was higher, was rising. Similar trends occurred in Denmark and Tuscany (Johansen 2002; Breschi 1990). Urbanization may also have created the appearance of a stable mortality pattern, or of slow gains in survival, in some other Western countries in the same period, including the United States, Germany, and the Netherlands. Thus, sustained improvements in survival may actually have begun earlier in these three countries than indicated in Appendix 1. That cannot be determined until historians learn more about regional differences in mortality levels and trends within those countries.

The first country-level health transitions began in the 1770s and the last began about two centuries later. Figure 2 shows the timing of, and the levels of life expectancy at, these initiations for the 119 countries for which a beginning-point estimate is available. Five countries—Australia (in the 1860s or 1870s at 48 years), New Zealand (1860s or 1870s at 51.8 to 53.1 years), Latvia (1890s to 1920s at 45), Bulgaria (1920s at 44.6), and Uruguay (1920s at 50)—appear to have begun health transitions with atypically high levels of life expectancy.⁵ Another small group began health transitions with life expectancies below 25 years: Pakistan at 20.1, Vietnam at 22.5, Korea at 23.5, Kenya and Uganda at 23.9, Sierra Leone at 24.5, and Bangladesh and India at 24.9. Most countries began with life expectancies between 25 and 35 years; the overall average was 33.1 years.

FIGURE 2 Timing and level of life expectancy at the initiation of health transitions (plotted by period of initiation)



NOTES: In 2a there are two data points for Europe in the 1920s at 41.7. In 2b there are two data points in the 1930s at 23.9. In 2c there are two data points in the 1920s at 24.9.
 SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

TABLE 1 Health transition beginning periods and life expectancy levels by region, 119 countries

Region	Number of countries	Range of beginning periods	Average beginning level (years)
Africa	43	1920s–1960s	31.4
Americas	23	1830s–1940s	32.9
Asia	23	1890s–1960s	31.0
Europe	25	1770s–1930s	36.8
Oceania	5	1870s–1940s	41.4

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

Table 1 reports the range of beginning periods and the average of beginning levels for these 119 countries allocated into five regions. Countries in Africa and Asia generally began health transitions later from lower levels; countries in Europe generally began the earliest health transitions and started from appreciably higher levels of life expectancy.

Table 2 shows simple averages of life expectancy at the beginning periods, without weighting for the sharply varying size of these 119 countries in the period of initiation. It does not show a chronological pattern. Most importantly, this table fails to suggest that countries that began health transitions later had an advantage in the *level* at which they began. More probably the reverse was true: the beginning level tended to deteriorate over time as countries initiated health transitions from more dismal starting positions.

Table 3 supplements information from Tables 1 and 2 to reveal more about the timing of health transition initiations by region. Scholars are nearly

TABLE 2 Health transition beginning periods and average levels of life expectancy, 119 countries

Period	Number of countries	Average beginning level (years)
1770s–1860s	8	35.8
1870s	8	40.3
1880s	2	37.4
1890s	6	31.6
1900s	5	34.0
1910s	2	31.3
1920s	20	33.8
1930s	12	29.6
1940s	17	31.7
1950s	36	32.3
1960s	3	35.5

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

TABLE 3 Number of countries beginning health transitions by period and region, 119 countries

Period	Africa	Americas	Asia	Europe	Oceania	Total
1770s–1840s	0	1	0	6	0	7
1850s–1860s	0	0	0	1	0	1
1870s	0	0	0	6	2	8
1880s	0	1	0	1	0	2
1890s	0	2	1	3	0	6
1900s	0	3	1	1	0	5
1910s	0	0	1	1	0	2
1920s	2	5	7	5	1	20
1930s	4	5	2	1	0	12
1940s	6	6	3	0	2	17
1950s	29	0	7	0	0	36
1960s	2	0	1	0	0	3
Total	43	23	23	25	5	119

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

unanimous in asserting that sustained gains in life expectancy occurred first in northwestern Europe and that for a long time Europe led the rest of the world in both the level of life expectancy achieved and the number of countries that made survival gains. Table 3 explicates that finding. Only a few countries managed to initiate health transitions before the 1890s, and most of those countries were in western Europe or were European offshoots: Canada, the United States, Australia, and New Zealand.

This table yields two other findings. First, health transitions began widely around the world in the 1890s and the following decades. By the 1920s every region was represented by at least two countries that had initiated sustained gains in survival. Second, most health transitions began before antibiotics and modern vaccines (as distinct from the smallpox vaccine) were available. Penicillin and the other antibiotics reached poorer countries at the end of the 1940s or in the early 1950s, and new and effective vaccines began to appear in the 1950s.

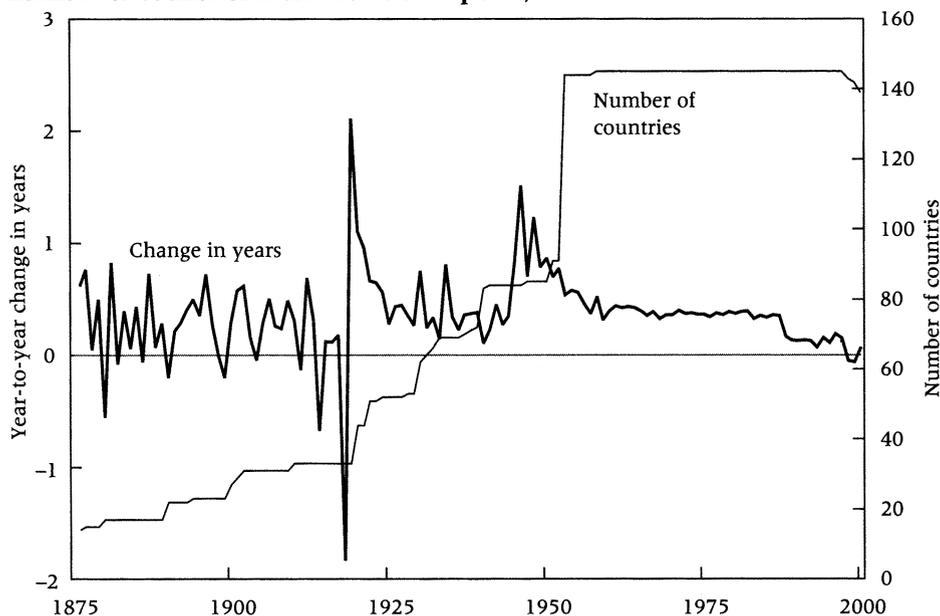
Pace of change

The global average life expectancy around 1800 was about 28.5 years, and the average in 2001 was 66.6 years (Riley 2005a). The average yearly gain between the two dates was about 0.19 years per year of calendar time, or about 2 years per decade. For some countries that initiated health transitions in the earliest period, the gains were slightly faster (France, beginning in the 1790s from a lower level, added life expectancy at an annual pace of 0.25 years). But, taken together, the seven countries that began health transitions

before 1850 managed a pace of only about 0.20 years' gain per year of calendar time. All subsequent health transitions have been much more rapid.

Figure 3 shows year-to-year changes in global life expectancy for the period 1875 to 2000 along with the number of countries included at each point. This figure is dominated by European experience up to 1920 because most countries reported on up to that date are in Europe and because annual (rather than periodic) estimates of life expectancy are more often available for countries in Europe than for those in other regions. The countries that had begun health transitions included about 10.5 percent of the global population in 1875, 32.4 percent in 1900, and 34.8 percent in 1913, jumping then to 86.7 percent in 1950 and, with the addition of most of sub-Saharan Africa, to 96.4 percent in 1960. A lengthy period of sharply irregular change closed around 1920. From then to 1950 year-to-year changes were somewhat less irregular, presumably in part because of the steady increase in the proportion of world population represented by countries that had initiated health transitions. After 1950 with a further sharp jump in that population, year-to-year changes greatly diminished. The pace of gains remained strong into the late 1980s, then dropped suddenly.

FIGURE 3 Year-to-year change in global life expectancy and number of countries included at each point, 1875–2000

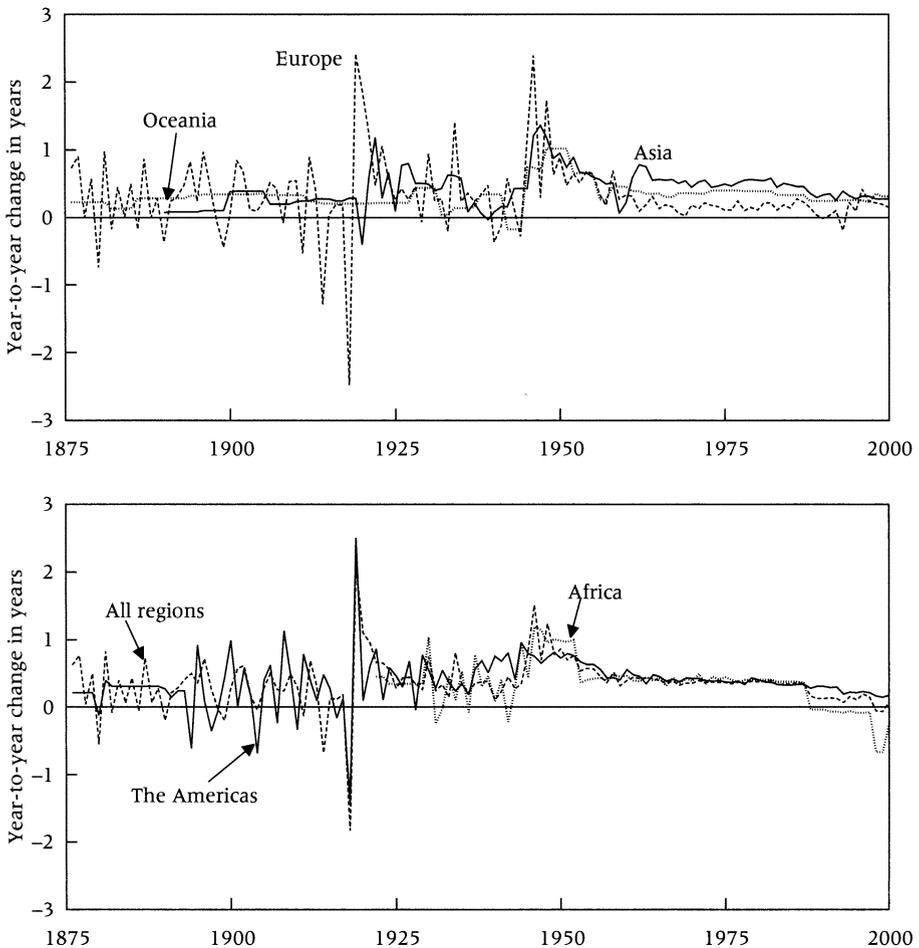


NOTE: In this figure countries are added, if estimates are available, at the beginning of the decade in which they initiated sustained gains in life expectancy, even though earlier estimates are available for some countries. These earlier estimates are not used since, for countries not yet experiencing gains in survival, the net change before the health transition was zero. Each year's change is associated with the following year, so that change from 1875 to 1876 is associated with 1876.

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

Figure 4 reports year-to-year changes for the five regions and for all regions together. The influenza pandemic of 1918–19 had a global impact. But the impact appears here in the form of sharp losses for 1918 and recovery in 1919 only in Europe and the Americas, because it is only for those regions that annual estimates of change are available for many countries in this period. Elsewhere most annual values have been derived from the average annual change between estimate points some years apart, which smoothes the annual values. The irregularity in year-to-year change in Europe and the Americas, which is especially evident up to 1920, presumably obtained in other regions of the world as well.

FIGURE 4 Year-to-year change in life expectancy for five regions, 1875–2000



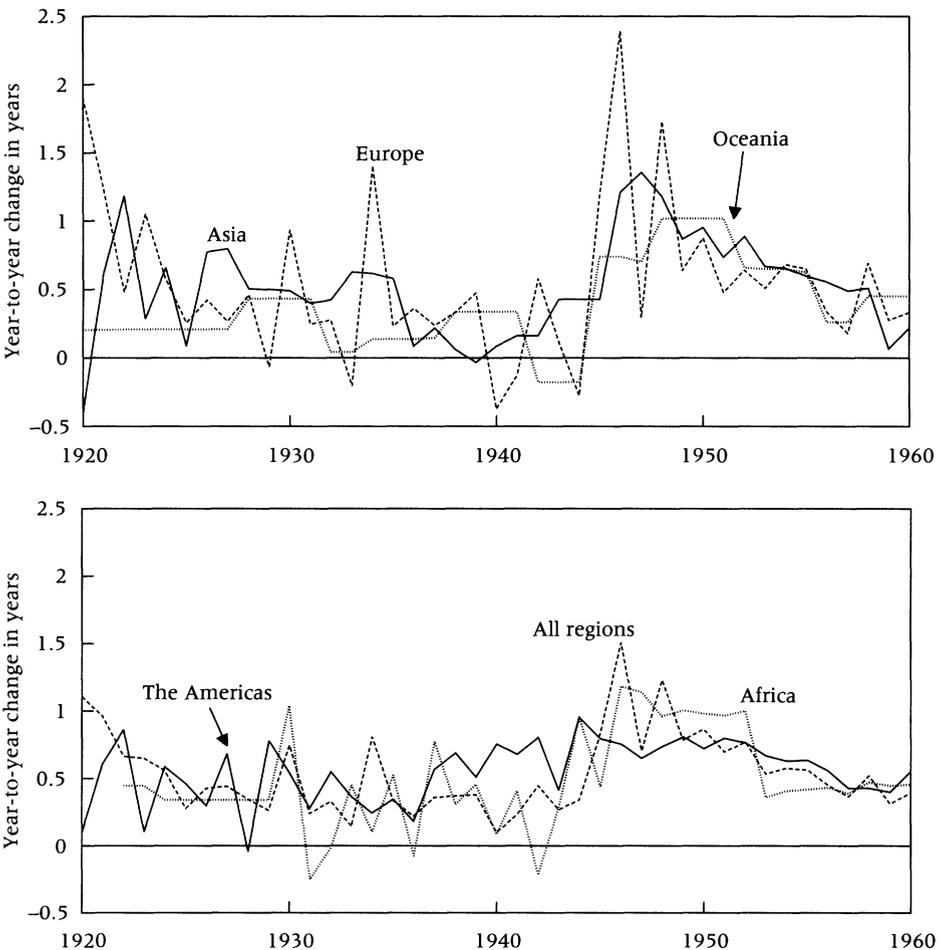
NOTE: See note to Figure 3.

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

Greater evenness in year-to-year gains among regions is apparent for the period 1960–85, but that is partly an artifact of using estimates from the World Bank’s World Development Indicators, which are smoothed. Other regions outpaced Europe, continuing to catch up with levels of life expectancy there. Then, in the late 1980s, gains in Europe slowed from the effect of stagnating or lowered survival in Soviet bloc countries. And in Africa changes turned negative around 1988. These are well-known developments that do not require further discussion here.

What Figure 4 shows that is less well known occurred in the period 1920–60 and is indicated in a detailed view in Figure 5, which reports aver-

FIGURE 5 Year-to-year change in life expectancy for five regions, 1920–1960



NOTE: See note to Figure 3.

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

age year-to-year changes in life expectancy among the countries in each region undergoing a health transition. This figure shows some familiar perturbations: the 1933 dip in Europe due to extraordinarily heavy mortality in the Soviet Union; heavy mortality in many European countries at the beginning of World War II and again in 1944. The first new insight from the figure is that the countries outside the West that initiated a health transition in the period 1920–39 usually managed to make strong gains, which were much higher than those achieved by health transition pioneers in the early parts of their transitions. In some years between 1920 and 1939 average annual gains among countries in the Americas and Asia surpassed those among countries in Europe. For all countries undergoing health transitions from 1920 through 1939 the average gain during that period was 0.48 years added to survival per year of calendar time. In Europe the pace was higher in that period than in any preceding period of at least a decade in length, chiefly because year-to-year change was more often positive. But the more important result is that so many countries outside Europe managed not just to initiate health transitions in this period or slightly earlier, but also to achieve rapid gains. These gains preceded the introduction to developing countries of antibiotics and the newer vaccines. No fully satisfactory overall explanation has yet been provided for such gains, although Riley (2005b) explains how Jamaica reduced mortality from fecal disease, malaria, and tuberculosis in the period 1920–50.

The second main insight from Figure 5 is that survival improved in 1945, as would be expected in countries where wartime mortality was high in 1944, and that rapid improvement continued for some years thereafter. Rapid gains in survival occurred in regions where the cause-of-death profile was still dominated by communicable diseases, some of which could now be managed or cured with antibiotics,⁶ but also in Europe where that profile was dominated by degenerative organ diseases, chiefly coronary heart disease, stroke, and cancer. From 1945 through 1952 the average pace of gains among all countries undergoing health transitions was an unprecedented 0.93 years per year of calendar time. Western countries with life expectancies already between 65 and 70 years participated in these gains as extensively as countries where life expectancies were as low as 30 to 40 years. Among the large and growing number of countries initiating and undergoing health transitions in the 1940s and 1950s, the gains in the period 1945–52 were unusually large and without regard to the existing level of life expectancy or the profile of the causes of death.

For 1945–52 medical innovations, especially antibiotics capable of managing tuberculosis and of both curing and abbreviating the course of most bacterial diseases and of wounds, may have played a significant role even though they were introduced in low-income countries later and more hesitantly than in high-income countries. But Figure 5 suggests that other fac-

tors must have been important, too, because diseases that could be successfully treated with antibiotics had already retreated in many of the countries included. Cause-of-death profiles and disease regimes differed sharply from region to region. Income, housing, literacy and education, health care availability, sanitary improvements, and other factors pertinent to survival also varied widely from country to country and region to region. What is puzzling is the similarity in outcome amid such variation in the operative causes. Although similar trends in life expectancy would ordinarily be taken to suggest a common cause, these simultaneous and rapid gains across regions cannot be explained by a single medical factor.

Most of the rapid-gain episodes occurred in the 1920s and afterward, although a few countries had achieved a remarkably high pace of gains earlier. Table 4 shows a sample of 62 such episodes, some comparatively speculative (e.g., China, Dominican Republic, El Salvador, Senegal, Uganda), along with many others secure in the quality of the estimates lying behind them. Many countries in Africa and Asia experienced rapid improvement in the period 1945–60, gains that scholars usually attribute to the dissemination of Western medicine. In another group of countries—Kuwait, Oman, Saudi Arabia, Venezuela, and perhaps Mexico—episodes of rapid improvement in survival coincided with the suddenly higher levels of public spending made possible by the discovery and exploitation of petroleum. And in yet a third group, certainly Sri Lanka and Mauritius and perhaps others, malaria and mosquito control via DDT led to rapid gains. But those cases do not cover the entire table. Some countries—for example, Argentina and Cyprus—were able to achieve rapid gains from an atypically early point, beginning in the 1890s. Chile, Costa Rica, Cuba, Jamaica, Trinidad and Tobago, and some others saw rapid improvements in survival from the 1920s onward, before the introduction of DDT, antibiotics, or other innovations from Western medicine and science.

Several of these rapid-gain episodes encompassed periods of war. Thus, China's life expectancy showed a large net gain from about 1930 to 1970, notwithstanding losses during the war with Japan and the civil war that followed. For the Soviet Union and Vietnam, too, periods of sizable net gain included years of war.

Even though some of these episodes may be products of inaccurate estimates of life expectancy at the beginning or concluding points, and thus of measurement error, there are quite enough cases in Table 4 to establish the validity of such episodes and to enlarge upon them from the best-known cases, such as Sri Lanka in the immediate post-World War II years or Japan in the 1950s. Indeed, the list in Table 4 is dominated by little-known episodes. These periods of rapidly increasing life expectancy are so numerous, so widely dispersed across regions, and so varied in the circumstances in which they occur that they suggest the possibility of the kind of rapid im-

TABLE 4 Episodes of rapid gains in life expectancy by region and period

Region/country	Period (approximate)	Years gained per year of calendar time
Africa		
Tunisia	1935 to 1985	0.68
Egypt	1939 to 1950	0.83
Algeria	early 1940s to late 1980s	0.70
Kenya	about 1945 to early 1950s	1.53
Senegal	about 1945 to late 1950s	0.63
Uganda	about 1945 to early 1950s	1.40
Zimbabwe	about 1944 to about 1960	1.05
Burundi (also Rwanda)	about 1950 to about 1960	about 1.0
Congo, Republic of	about 1950 to about 1960	0.83
Lesotho (also Swaziland)	about 1950 to about 1960	0.73
Morocco	early 1950s to 1965	0.54
Namibia	about 1950 to about 1960	1.14
Togo	about 1950 to about 1960	0.82
Libya	early 1970s to late 1980s	0.90
Gambia	about 1982 to about 1990	1.04
The Americas		
Argentina	late 1890s to early 1920s	0.68
United States	1920 to 1932	0.71
Trinidad and Tobago	1920 to 1960	0.62
Chile	about 1920 to 1960	0.65
Guyana	about 1921 to 1960	0.57
Costa Rica	1925 to 1975	0.70
Cuba	1925 to 1975	0.67
Jamaica	early 1920s to early 1950s	0.68
Mexico	1925 to mid-1950s	0.81
El Salvador	1930 to 1950	0.93
Panama	1930 to 1960	0.83
Paraguay	early 1930s to about 1960	1.01
Dominican Rep.	1935 to 1975	0.78
Guatemala	1940 to 1950 and early 1960s to early 1970s	1.17 and 0.64
Brazil	1940 to early 1950s	1.11
Nicaragua	1940 to 1960	0.64
Puerto Rico	1940 to 1960	1.17
Venezuela	early 1940s to 1960	1.33
Honduras	late 1950s to late 1980s	0.70

.../continued

TABLE 4 (continued)

Region/country	Period (approximate)	Years gained per year of calendar time
Asia		
Cyprus	1895 to 1905	0.65
Korea	early 1920s to late 1930s	0.87
Sri Lanka	early 1920s to 1950	0.85
Iran	about 1926 to 1975	0.62
China	about 1930 to 1970	0.78
Kuwait	1930s or 1940s to present	0.63
Oman	1930s or 1940s to present	1.03
Philippines	late 1930s to early 1960s	0.61
India	late 1940s to 1960	0.94
Indonesia	1945 to 2000	0.70
Taiwan	1940 to 1960	0.92
Turkey	late 1940s to late 1950s	0.75
Japan	1948 to 1963	0.81
India	1950s	0.72
Saudi Arabia	1950 to 1990	0.86
Syria	1950 to 1960	0.62
Thailand	1950 to 1960	1.09
Vietnam	1950 to 1980	0.74
Bahrain	early 1950s to early 1980s	0.60
Qatar	early 1950s to late 1970s	0.70
South Korea	mid-1950s to late 1970s	0.66
Bangladesh	1977 to 1997	0.65
Europe		
Spain	1920 to 1960	0.70
Bulgaria	1937 to 1960	0.74
Albania	1938 to 1960	1.04
Soviet Union	1934 to 1958	1.20
Oceania		
Mauritius	mid-1940s to 1960	1.56
Papua New Guinea	1946 to 1965	0.70

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

provement that can be hoped for in low-income countries where today survival rates still remain low. Most of these episodes occurred before, or during the earliest stages of, economic development.

Particularly rapid gains have occurred in two forms: post-crisis recoveries and stand-alone episodes of rapid mortality reduction. In the years 1875–2000 post-crisis periods were often characterized by early and rapid recovery in life expectancy and, on some occasions, by recoveries that more than made up for the effects of the crisis. Andreev and associates (1992)

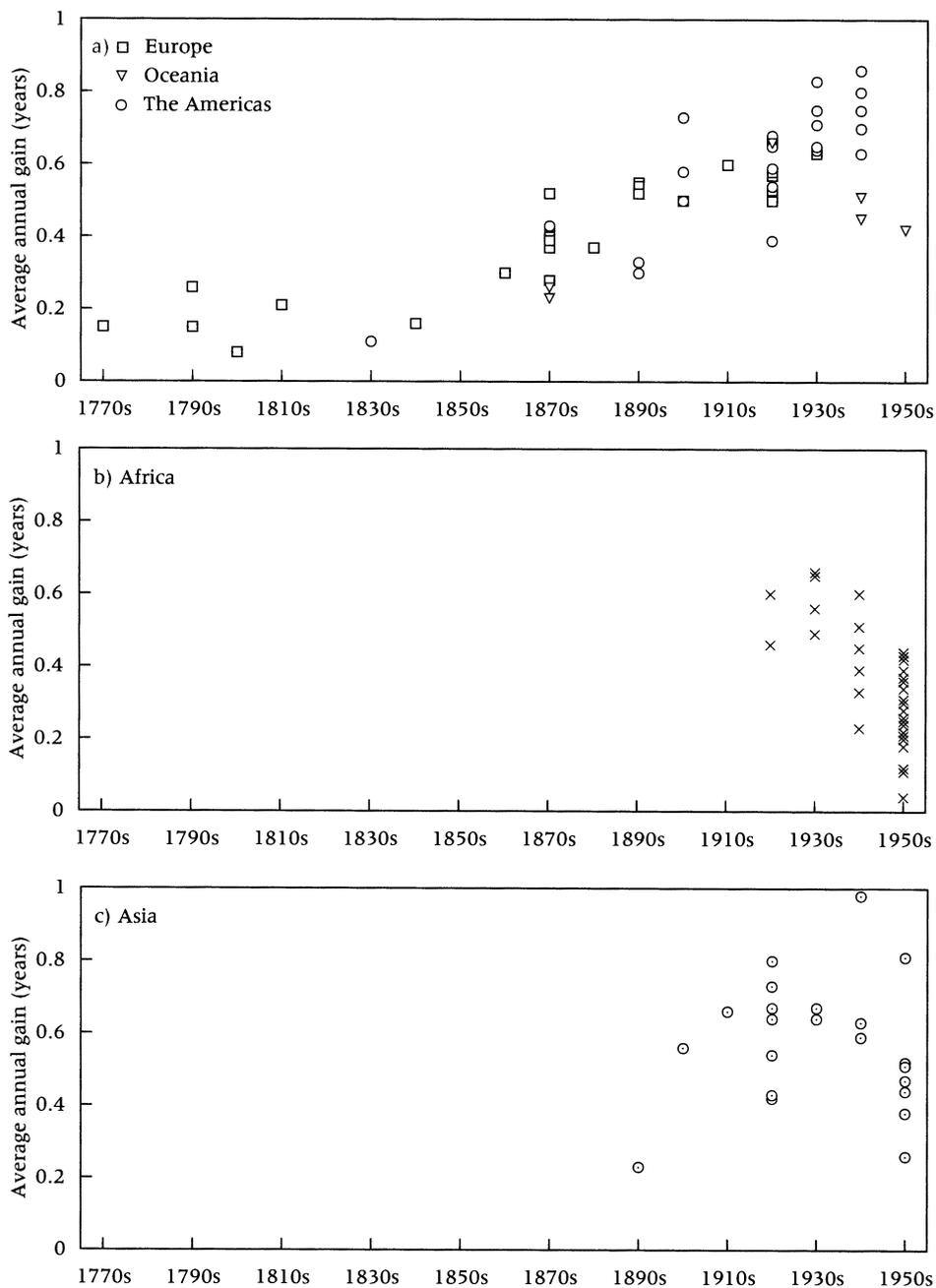
estimate that life expectancy in the Soviet Union dropped from 32.8 years in 1932 to 11.6 in 1933 and then recovered in 1934 to 38.2 years. During World War II Japan's life expectancy plunged from a prewar level of 48.2 years (in 1935) to 30.5 years in 1945, but recovered to 52 in 1947 and 57.5 in 1948. Ukraine's life expectancy fell from 50 years in 1939 to 18.2 in 1943 but then recovered to 55.2 years in 1946. And Jamaica's life expectancy dropped from 35.6 years in 1916 to 26.4 in 1918, even though the influenza epidemic occurred only in the latter part of that year, and then recovered in 1919 to 36.6 years. Ordinary safeguards, which collapse during a crisis, are reactivated in the aftermath, allowing quick recovery to former

TABLE 5 Pace of gains in the first 50 years of each country's health transition

Average gain per year of calendar time	Countries exhibiting that pace
<0.10 years	England/England and Wales, Zambia
0.10–0.19	Belgium, Botswana, Canada, Denmark, Malawi, Mali, Rwanda, Sweden
0.2–0.29	Afghanistan, Australia, Burkina Faso, Burundi, Central African Rep., Djibouti, Ethiopia, France, Ivory Coast, Liberia, Japan, New Zealand, Niger, Norway, Scotland, Sierra Leone, Swaziland, Tanzania
0.3–0.39	Angola, Cambodia, Cameroon, Chad, Congo Rep., Costa Rica, Equatorial Guinea, Guinea, Guinea Bissau, Ireland, Italy, Lesotho, Mauritania, Mexico, Netherlands, Senegal, Somalia, Switzerland, Togo, Uruguay
0.4–0.49	Bangladesh, Benin, Finland, Gabon, Gambia, Germany, Ghana, Indonesia, Madagascar, Mongolia, Namibia, Nigeria, Solomon Islands, Uganda, United States, Yemen
0.5–0.59	Argentina, Austria, Bulgaria, Cuba, Cyprus, Czech Rep., Egypt, Estonia, Guyana, Iceland, India, Latvia, Libya, Lithuania, Myanmar, Nepal, Papua New Guinea, Russia, Spain, Thailand, Trinidad and Tobago
0.6–0.69	Albania, Algeria, Brazil, Chile, China, Colombia, Greece, Honduras, Iran, Jamaica, Kenya, Mauritius, Pakistan, Peru, Philippines, South Korea, Tunisia, Ukraine, Vietnam, Zimbabwe
0.7–0.79	Bolivia, Dominican Rep., Guatemala, Puerto Rico, Sri Lanka, Venezuela
0.8–0.89	El Salvador, Nicaragua, Paraguay, Saudi Arabia, Taiwan
0.9–0.99	Kuwait

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

FIGURE 6 Distribution of average annual gains in the first 50 years of health transitions (plotted by period of initiation)



NOTES: In 6a there are two data points for the Americas in the 1940s at 0.63. In 6b there are two data points in the 1950s at 0.24, 0.25, 0.26, 0.30, 0.34, 0.36, 0.39, and 0.43.

SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

levels of survival. Furthermore, mortality crises often carry off the frailest people so that post-crisis survival is higher because of a temporary change in population composition (e.g., Noymer and Garenne 2000).

Another way to scrutinize differences in the pace of change is to compare gains in the first 50 years of each country's health transition. Figure 6 shows the distribution of average annual gains for the 116 countries for which estimates of life expectancy are available for the beginning point and for 50 years later, and Table 5 ranks each country in a hierarchy of gains during the first 50 years of health transition, ranging from less than 0.1 years per year of calendar time to more than 0.9 years. Among these countries the average annual pace of gains rose to its highest level in the 1930s and 1940s and then, largely because of HIV/AIDS and its inroads into life expectancy in many countries in Africa in the late 1980s and 1990s, declined among a number of countries initiating health transitions in the 1950s. As Table 5 shows, England and Wales, beginning in the 1800s, and Zambia, beginning in the 1950s, managed the slowest pace of overall gain in the first 50 years, while Kuwait, beginning in the 1930s or 1940s, achieved the most rapid pace. (Oman began too late to have finished 50 years of persistent survival gains by 2000; during 1965–2000 its pace was 0.8 to 0.95 years per year of calendar time.) Many countries have temporarily achieved gains surpassing 0.6 years per year of calendar time.

Conclusion

Scholars seeking explanations for improvements in survival have concentrated on a few of the countries that pioneered health transitions and especially on England and Wales, France, and Sweden. It is true, as a statistical analysis would show, that the period in which a country began its health transition strongly predicts its current level of life expectancy; the countries that began earlier have in general made more progress. Nevertheless, the pioneer countries do not appear, from the exploration reported here, to have been the most illuminating cases because their transitions were atypically slow. By 2000 a number of low-income countries—among them Albania, China, Jamaica, Libya, and Sri Lanka—had attained high life expectancies even though they began health transitions between the 1920s and the 1960s; their experience seems more pertinent to the challenge of understanding how to promote survival gains in countries where life expectancy remains low.

Likewise the emphasis typically given to national case studies may be misplaced. Table 4 and Appendix 1 point up a large number of episodes of rapid survival gains that began as early as the 1890s and occurred under circumstances quite varied in time, stage of a country's economic development, historical conditions, and levels of literacy and education, among other

critical factors. For the sake of spurring gains against high mortality in the future, it may be useful to acquire a better understanding of these episodes, especially the ones that cannot be dismissed as special cases. More generally, the higher increments in life expectancy in the period 1920–39 demand better understanding because they occurred in many countries and preceded the introduction of antibiotics and the new vaccines of the 1950s. And they were typically won against fecal diseases, tuberculosis, and malaria, which remain important causes of death in low-survival countries.

The increments of the period 1945–52 also await close study. Even though they may have been assisted by the introduction of antibiotics and the dissemination of these new drugs in non-Western countries, and especially by the introduction of streptomycin to treat and manage tuberculosis, the higher increments in this period and their generality across the globe, including countries where maladies that could be treated with antibiotics no longer played a key role in causing death, suggest that other factors were at work, too.

Finally, this exercise implies that investigations of life expectancy gains should be comparative. The classical approach has been to select a single country and to analyze some period or feature of its mortality history. It will often be more useful in future studies to treat each country in context, not simply by considering neighboring countries that had some similarities in experience, but also by making comparisons more distant in space and time and selecting countries and regions for comparison purposefully to test the explanations of mortality change given for the case study country.

APPENDIX 1 Chronology of health transitions

Beginning period and (in parentheses) year used as beginning point	Country ^a	Life expectancy around beginning of transition	Life expectancy in 2000	Gain per year of calendar time	Life expectancy first equaled or passed 65 years in
1770s (1775)	Denmark	c. 33	76.4	0.19	1939
1790s (1795)	France	28.1	78.6	0.25	1948
1800s (1805)	Sweden	35.3 (during 1781-90)	79.7	0.22	1938
	England and Wales	36.3 (England only during 1796-1805)	77.7 (during 1998-2000)	0.21	c. 1944
1810s (1815)	Norway	38.3 (during 1801-15)	78.6	0.22	1933
1820s or 1830s (1830)	Canada	39.0	78.9	0.24	1944
1840s (1845)	Belgium	38.3 (during 1843-50)	78.4	0.26 (from 1845)	1949-50
1820s to 1890s (1860)	Ireland	38.3 (during 1821-41)	76.3	0.22 (from 1821-41)	c. 1950
1860s or 1870s (1870)	Australia	48.0	78.9	0.24	c. 1930
	Netherlands	37.3 (during 1850-59)	77.9	0.31	c. 1933
1860s to 1900s (1890)	New Zealand	51.8 to 53.1 (during 1870s)	78.2	0.20	late 1920s
1870s (1875)	Mexico	24 to 29	73.0	0.34 to 0.49	1976-77
	Finland	32.1	77.5	0.36	1950-52
	Germany	36.7 to 38.4	77.4	0.32	1947-49
	Iceland	32.3	79.5	0.38	1936-44
	Scotland	42.1 (during 1860s)	75.4	0.27	c. 1947
1870s or 1880s (1880)	Switzerland	40.3 to 40.7 (during 1876-78)	80.3	0.32	1941-42
	Italy	35.4 (during 1881-82)	78.7	0.36	c. 1950
	Luxembourg	n.a.	77.0	n.a.	1950
1870s to 1890s (1890)	Japan	36.6 (during 1870)	80.7	0.37	1955
1880s (1885)	Poland	n.a.	73.3	n.a.	1956-58
	United States	39.4 (1880)	77.1	0.33	1942
	Austria	40.5 (1880 whites only)	78.2	0.42	1951
1880s or 1890s (1890)	Hungary	31.7 (during 1865-75)	71.3	n.a.	c. 1954
1890s (1895)	Czech Rep.	35	74.8	0.38	1952-53
	Slovakia	n.a.	73.1	n.a.	1950s
	Spain	29.5 (during 1878-87)	78.2	0.46	mid-1950s
1890s or 1900s (1900)	Argentina	33.3	73.9	0.41	1959-60
	Cyprus	38.5 (during 1890s)	77.9	0.39	1950
	Russia	31 (1897)	65.3	0.34	1956-57

1890s to 1920s (1890)	Costa Rica	1890s: 30.5 1920s: 33.3 to 34.1	77.5	0.45 to 0.58	c. 1966
(1920)	Estonia	43.1 (c. 1900)	70.6	0.34	1950s
(1920)	Latvia	45 (during 1896–97)	70.4	0.25	1950s
(1920)	Lithuania	41.7 (c. 1900)	72.6	0.31	1950s
1900s (1905)	Ukraine	36.6 (c. 1900)	68.3	0.32	1955
	Cuba	33.1 to 38.4	76.5	0.43	1961–62
1900s or 1910s (1910)	Puerto Rico	30.4 to 32.1 (1894)	76.1	0.47	1952–53
1900s to 1920s (1920)	Greece	38 to 40	77.9	0.43	early 1950s
	Singapore	n.a.	77.7	n.a.	1963–64
	Yugoslavia	n.a.	72.5	n.a.	1963–64
1910s (1915)	Korea	23.5	73.2 South 60.7 North	0.58 South 0.44 North	1976–77 North
	Panama	n.a.	74.6	n.a.	1969–70
1910s or 1920s (1920)	Romania	n.a.	69.9	n.a.	c. 1964
1910s to 1930s (1930)	Malaysia	n.a.	72.5	n.a.	c. 1976
	Philippines	25.6 to 37.5 (1918)	69.3	0.50	c. 1989
1920s (1925)	Bangladesh	24.9 (during 1921–31)	61.2	0.48	not by 2000
	Bulgaria	44.6	71.6	0.36	c. 1965
	Chile	31.6	75.7	0.59	1974–75
	China	24.2 to 35	70.3	0.54	1976–79
	Fiji	n.a.	69.2	n.a.	1983–84
	Ghana	28	56.9	0.39	not by 2000
	Guyana	31.1 (1911)	62.9	0.42	not by 2000
	India	24.9	62.8	0.51	not by 2000
	Indonesia	30	66.0	0.48	1996–97
	Jamaica	37.0	75.3	0.51	1961–62
	Mauritius	31.2	71.7	0.54	1978–79
	Pakistan	20.1 (1921)	63.0	0.57	not by 2000
	Portugal	n.a.	75.7	n.a.	1963–64
	Sri Lanka	29.9 (1911)	73.1	0.58	1971–72
	Surinam	n.a.	70.2	n.a.	1976–77
	Taiwan	30.8 (during 1911–20)	76.4	0.61	1962
	Trinidad and Tobago	39.4	72.6	0.44	1968–70
	Tunisia	28.8	72.1	0.58	c. 1985
	Uruguay	50.0	74.4	0.33	1948–49

/continued

APPENDIX I (continued)

Beginning period and (in parentheses) year used as beginning point	Country ^a	Life expectancy around beginning of transition	Life expectancy in 2000	Gain per year of calendar time	Life expectancy first equaled or passed 65 years in
1920s or 1930s (1930)	Albania	< 38.3	74.0	0.63	c. 1975
	Brazil	32.0	68.1	0.52	1988-89
	Paraguay	26.1 (1899)	70.4	0.63	1968-69
	South Africa	n.a.	47.8	n.a.	not by 2000
	Turkey	n.a.	69.7	n.a.	1988-89
	Venezuela	32.2 (1926)	73.4	0.59	1969-70
	Vietnam	22.5	69.1	0.67	1991-92
	Algeria	31.2	71.0	0.61	1987
	Colombia	32 to 40	71.6	0.55	1978-79
	Egypt	31 to 32	67.5	0.55	1994-95
1930s (1935)	Guatemala	25.8	65.2	0.61	1998-2000
	Jordan	n.a.	71.5	n.a.	1983-84
	Kenya	23.9	47.0	0.36	not by 2000
	Syria	n.a.	69.7	n.a.	1987
	Uganda	23.9	42.1	0.28	not by 2000
	Bolivia	25.5 (1900)	62.6	0.62	not by 2000
	Congo, DR	n.a.	45.8	n.a.	not by 2000
	Dominican Rep.	29.9	67.3	0.62	1988-90
	Ecuador	n.a.	69.6	n.a.	1983-84
	El Salvador	28.7	70.2	0.69	1989-90
1930s or 1940s (1940)	Honduras	33.9 (1930)	66.0	0.54	1991-92
	Iran	25 (1926)	69.1	0.74	c. 1991
	Iraq	n.a.	61.1	n.a.	1988?
	Kuwait	26	76.6	0.84	1968-69
	Laos	n.a.	53.7	n.a.	not by 2000
	Lebanon	n.a.	70.4	n.a.	1971
	Libya	42.9 (1950)	71.0	0.56	c. 1984
	Morocco	n.a.	67.5	n.a.	1993-95
	Namibia	31.3 to 38.7 (1950)	47.2	0.24	not by 2000
	Nicaragua	24.4 (1921)	68.9	0.74	c. 1991

Peru	36.4 (1940)	69.3	0.55	1988-89
Qatar	n.a.	74.8	n.a.	1976-77
Senegal	23.9 to 36.4	52.3	0.37	not by 2000
Sudan	n.a.	56.2	n.a.	not by 2000
Thailand	38.3 to 40.3	68.8	0.49	1981-82
UAE	n.a.	75.3	n.a.	1975
Zimbabwe	26.4 (during mid-1930s)	39.9	0.23	not by 2000
Burundi	c. 31	42.0	0.22	not by 2000
Cape Verde	n.a.	68.8	n.a.	1989-90
Myanmar	30.8 (1926)	56.1	0.46	not by 2000
Rwanda	33.5 (1950); 39 (1970)	39.9	0.07	not by 2000
Bahrain	n.a.	73.1	n.a.	c. 1976
Lesotho	35.9 (1950)	44.0	0.16	not by 2000
Papua New Guinea	31.5 (1946)	58.6	0.49	not by 2000
Sierra Leone	24.5 (1931)	39.2	0.27	not by 2000
Solomon Islands	44.0 (1950-55)	68.6	0.45	1991-92
Afghanistan	30.2	43.0	0.26	not by 2000
Angola	27.0	46.6	0.39	not by 2000
Benin	c. 31	53.0	0.44	not by 2000
Botswana	c. 33	39.0	0.12	not by 2000
Burkina Faso	c. 31	44.2	0.26	not by 2000
Cambodia	35.0 or less	53.8	0.34	not by 2000
Cameroon	28.8 (1931); 33.5 (1950)	50.1	0.33	not by 2000
Central African Rep.	c. 33	43.5	0.21	not by 2000
Chad	c. 30	48.5	0.37	not by 2000
Comoros	n.a.	60.7	n.a.	not by 2000
Congo Rep.	c. 32	51.3	0.39	not by 2000
Djibouti	c. 33	45.8	0.28	not by 2000
Equatorial Guinea	c. 34	49.1	0.30	not by 2000
Eritrea	n.a.	51.0	n.a.	not by 2000
Ethiopia	c. 30	42.3	0.25	not by 2000
Gabon	c. 31	52.7	0.43	not by 2000
Gambia	30 to 33.5	53.3	0.43	not by 2000
Guinea	c. 31	46.3	0.31	not by 2000
Guinea Bissau	c. 28	44.9	0.34	not by 2000

/continued

APPENDIX 1 (continued)

Beginning period and (in parentheses) year used as beginning point	Country ^a	Life expectancy around beginning of transition	Life expectancy in 2000	Gain per year of calendar time	Life expectancy first equaled or passed 65 years in
	Haiti	n.a.	53.2	n.a.	not by 2000
	Ivory Coast	c. 32	45.8	0.28	not by 2000
	Liberia	34.5 (1950)	47.2	0.25	not by 2000
	Madagascar	33.5 (1950)	54.7	0.42	not by 2000
	Malawi	33.5 (1950)	38.8	0.11	not by 2000
	Mali	33.5 (1950)	42.3	0.18	not by 2000
	Mauritania	33.5 (1950)	51.7	0.36	not by 2000
	Mongolia	42.2 to 45 (during 1950-55)	67.0	0.47	1996-97
	Nepal	33.1 (1950)	58.9	0.52	not by 2000
	Niger	33.5 (1950)	45.7	0.24	not by 2000
	Nigeria	20 to 32 (1931)	46.8	0.42	not by 2000
	Saudi Arabia	30 to 34.5	72.5	0.83	c. 1984
	Somalia	33 to 33.5 (1950)	48.1	0.30	not by 2000
	Swaziland	33.4 (1950)	45.6	0.24	not by 2000
	Tanzania	34.2 (1950)	44.4	0.20	not by 2000
	Togo	31.3 (1950)	49.3	0.36	not by 2000
	Yemen	34.7 (1950)	56.5	0.44	not by 2000
	Zambia	36 (1950)	38.0	0.04	not by 2000
1940s to 1970s (1965)	Mozambique	32 to 33.5 (1950)	42.4	0.24	not by 2000
	Oman	40.3 (1960)	73.6	0.95	1983-84

n.a. = not available.

^aNotes about individual countries appear in the bibliography.

SOURCES: See the bibliography at «www.lifetable.de/Riley/Bib.htm».

Notes

1 Using a wider array of sources and estimates, this exercise revisits questions posed by Gwatkin (1980). Whereas Gwatkin looked ahead, taking a pessimistic view of prospects for continued gains in life expectancy in developing countries, this exercise looks at past change, identifying periods of especially rapid increments in survival.

A number of scholars and institutional reports have examined regional and global levels and trends of life expectancy since the 1940s, among them United Nations (1953), which was prepared by J. J. Spengler, F. Lorimer, and others; Stolnitz (1955, 1956); Davis (1956); United Nations (1963); Veron (1980); United Nations and World Health Organization (1982); Dupâquier (1984); Bähr and Wehrhahn (1993); Meslé and Vallin (2000); Vallin and Meslé (2003); and Moser, Shkolnikov, and Leon (2005).

2 One hundred sixty-seven countries qualify for inclusion by the size of their 2000 population; 145 of those will be discussed here, and, in addition, Iceland, which is included because of the high quality and lengthy series of its vital statistics. Estimates of life expectancy at the starting point of health transitions are available for 119 countries.

Scotland and England and Wales are treated separately. Most countries formerly part of the Soviet Union and of Yugoslavia have been excluded because of the difficulty

of finding information, but Russia and Ukraine are included, along with Yugoslavia. Israel has been omitted because of the difficulty of establishing when its population in 1947 or any point thereafter initiated a health transition. The West Bank and Gaza have been left out because available estimates begin only in recent decades. Countries with populations under 400,000 are excluded because, even together, they contribute only a small fraction of the global population, and because survival estimates before 1960 are rarely available for them.

3 Because of its length, this bibliography is furnished separately and on the web. Go to «www.lifetable.de/RileyBib.htm». Readers are invited to identify sources in any language not included in that bibliography that may also supply information about the timing of the initiation of a country's health transition and life expectancy before and after the beginning of that transition. Please contact the author of this article «rileyj@indiana.edu».

4 But gains have been distinctly slower in Canada, Denmark, the Netherlands, and the United States.

5 The estimates for Australia, New Zealand, and Uruguay exclude the indigenous populations, and therefore are artificially high. Those for Latvia and Bulgaria may be biased upward.

6 For example, in Asia; see Veron (1980).

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