



## LIFE-SPAN AND LIFE EXPECTANCY



➔ **RAY KURZWEIL, GOOGLE'S CHIEF FUTURIST**, says that if you can just hang on until 2029, medical advances will start to “add one additional year, every year, to your life expectancy. By that I don't mean life expectancy based on your birth date but rather your remaining life expectancy.” Curious readers can calculate what this trend would do to the growth of the global population, but I will limit myself here to a brief review of survival realities. • In 1850, the combined life expectancies of men and women stood at around 40 years in the United States, Canada, Japan and much of Europe. Since then the values have followed an impressive, almost perfectly linear increase that nearly doubled them, to almost 80 years. Women live longer in all societies, with the current maximum at just above 87 years in Japan. • The trend may well continue for a few decades, given that life expectancies of elderly people in affluent countries rose almost linearly from 1950 to 2000 at a combined rate of about 34 days per year. But absent fundamental discoveries that change the way we age, this trend to longer life must weaken and finally end. The long-term trajectory of Japanese female life expectancies—from 81.91 years in 1990 to 87.26 years in 2017—fits a symmetrical logistic curve that is already close to its asymptote of about 90 years. The trajectories for other affluent countries also show the approaching ceiling. Records available show two distinct periods of rising longevity: Faster linear gains (about 20 years in half a century) prevailed until 1950, followed by slower gains. • If we are still far from the limit to the human life-span, then the largest survival gains should be recorded among the oldest people. This was indeed the case for studies conducted in France, Japan, the United States, and the United Kingdom from the 1970s to the early 1990s. Since then, however, the gains have leveled off.

There may be no specific genetically programmed limit to life-span—much as there is no genetic program that limits us to a specific running speed. But life-span is a bodily characteristic that arises from the interaction of genes with the environment. Genes may themselves introduce biophysical limits, and so can environmental effects, such as smoking.

The world record life-span is the 122 years claimed for Jeanne Calment, a Frenchwoman who died in 1997. Strangely, after more than two decades, she still remains the oldest survivor ever, and by a substantial margin. (Indeed, the margin is so big as to be suspicious: Her age and even her identity are in question.) The second oldest supercentenarian died at 119, in 1999, and since that time there have been no survivors beyond the 117th year.

And if you think that you have a high chance to make it to 100 because some of your ancestors lived that long, you should know that the estimated heritability of life-span is modest, just between 15 and 30 percent. Given that people tend to marry others like themselves, a phenomenon known as assortative mating, the true heritability of human longevity is probably even lower than that.

Of course, as with all complex matters, there is always room for different interpretation of published statistical analyses. Kurzweil hopes that dietary interventions and other tricks will extend his own life until such time as major scientific advances can preserve him forever. It is true that there are ideas on how such preservation might be achieved, among them the rejuvenation of human cells by extending their telomeres, the nucleotide sequences at the ends of a chromosome that fray with age. If it works, maybe it can lift the realistic maximum well above 125 years.

But in 2019 the best advice I can give to all but a few remarkably precocious readers of these essays is to plan ahead—but not as far ahead as the 22nd century. ■

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