Don’t Count on Both Presidents Trump and Biden Dying by Natural Causes in the Next 5 Years, Though One Probably Will

Charles Dermer

January 30, 2024

Abstract

Mortality rates derived from US population data are used to estimate the 50% survival ages for US men of Trump’s (77.5 yr) and Biden’s (81.2 yr) current ages as of January, 2024. Also, I estimate the probabilities for elderly US men with the same ages as Trump and Biden dying in the next 5 years using mortalities characterizing this group. The probabilities are at the 70% level for Trump and at the 60% level for Biden that US men of corresponding ages live to January 2029. The odds are only 10% that comparably aged men will both die in the next 5 years. Enhanced presidential mortality can however still be severe.

Intro

In a recent paper[1] on telomeres and mortality, I described a technique to derive male and female mortality rates from age-stratified population data. The method was applied to UN population data for 5-yr male and female age cohorts during epoch 2010-2014 for 5 different countries. An unusual mortality spike in the Hungarian data was linked[2] to toxic effects of Chernobyl.

In my latest paper,[3] I made a more wide-ranging study of population evolution and decline, with reference to the ongoing conflict in Ukraine.

As a matter of more than academic interest, here I make a simple calculation of the expected survival probability of our current president and his immediate predecessor. The very unlikely assumption that these two men face the same mortality as the average male member of the American public is recognized. Precisely, I estimate the average ages to which 50% of US men with the same ages as our current and previous presidents survive, and their 50% 5-yr survival probabilities.

Certainly, additional detailed medical information about Trump and Biden can only sharpen and improve these estimates. The results may be thought of as establishing Bayesian priors, and could also enlighten betting pools. I offer them here as a free public service.

Data and Theory

Trump, born June 14, 1946, is 77.5 years of age (yo), and Biden, born November 20, 1942, is 81.2 yo as of 1/2024. They are old, if the elderly are defined as those whose age exceeds the average life expectancy of the country in which they inhabit.* According to this website[4] that derives its data from the Office of Social Security of the US government, average life expectancy at birth in 2023 is 74.1 yrs for US men, and 79.8 yrs for US women,†

*By this definition, I am still young, or at least not elderly. Cf. Ref.[1].

†Note that these ages are bracketed by the range recorded in Psalms 90:10.

Male and female US mortality rates are calculated for the following epochs: 1990-1995, 2000-2005, 2010-2015, 2018-2023, using, as before, UN population data provided by PopulationPyramid.net.[5] (We anxiously await the 1-yr data.)

The results are shown in Fig. 1 for the 4 epochs, as labeled, for persons 60 years of age and older. Though we are focused here on male mortality, the female mortality rates are plotted for comparison. As can be seen, US female mortality is almost uniformly and sometimes markedly less than US male mortality for US mortality This follows the general rule that male mortality is less than female mortality that I've found in 6 of 7 other nations,† Ukraine being the exception.[3]

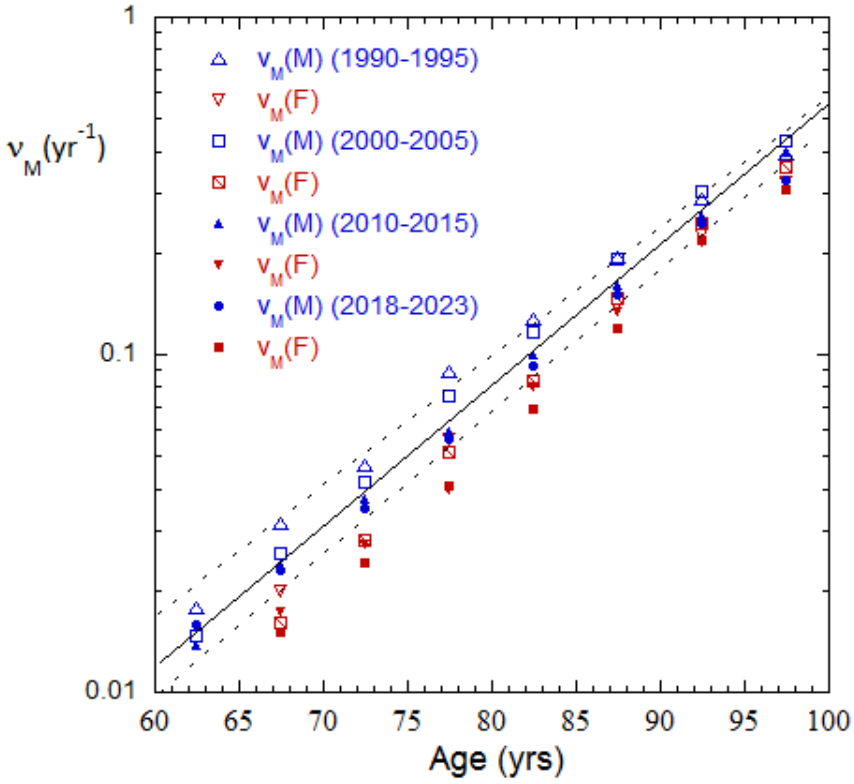

Figure 1. Mortality rates derived from US population data for the epochs labeled. The lines define the range of power-law fits to the male mortality used in the probability estimates.

A few points can be made about Fig. 1. First, the mortality rate in the 60-100 yo age range is quite well described by an exponential function with age that displays a relatively constant slope and only a weak epoch-dependent amplitude. The mortality rates decrease with time between the first and second two epochs by ~ 10-30%. Flattening in the elderly mortality rate at > 90 yo, (predicted in the telomere loss model[1]) could be resolved with studies of >100 yo persons. The probability of living much beyond 100 yrs is small, and beyond 115 yrs inconceivably small, as demonstrated in Appendix A for power-law mortality laws.

†China, Iceland, Hungary, Japan, Slovakia, Ukraine, Belarus, and the USA.

The use of power-law approximations to the rates is perfectly adequate for the purposes of the present exercise. The steady-state solution to the population equation for a power-law mortality rate law plus uniform mortality background at the level of ν_{min} was given in Ref.1 by

$$\frac{N(t)}{N(t_0 \to 1)} = \exp\left[-\nu_{min} t - \left(\frac{\nu_0}{k_1}\right)\left(e^{k_1 t} - 1\right)\right] . \qquad (1)$$

Equivalently, this is the average individual survival probability for the specified mortality rates. Here, contemporary old-age male and female mortality rates are described by a function of the form $\nu_M(t)\ [\ yr^{-1}] = \ \nu_{min} + \ \nu_o \exp(k_1 t)$, where $k_1 \equiv \ln(\nu_{t_2}\ /\nu_{t_1})\ /(\ t_2 - t_1)$, ν_{t_1} and ν_{t_2} are the mortality rates at t_1 and t_2 years of age taken from the Fig. 1 fits, and $\nu_0 = \ \nu_1 \exp(-k_1 t_1)$.

Calculations

The fits to the range of US male mortalities shown in Fig. 1 use the values in Table 1 below to define the mortality range: Also, the background mortality is chosen to be $\nu_{min} = 0.0003\ \text{yr}^{-1}$, a sufficiently small value that the total mortality is dominated by the rising exponential for the old, >>60 yo, population.

Table 1. Mortality rate coefficients.	ν_{t1} (t_1 = 60 yo)	ν_{t2} (t_2 = 100 yo)
High	0.017 yr^{-1}	0.58 yr^{-1}
Medium	0.012	0.56
	ν_{t1} (t_1 = 65 yo)	
Low	0.015	0.48

The 50% probability to reach age $<t_{1/2}>$ given current age t_P is obtained by numerically solving

$$\int_{t_P}^{<t_{1/2}>} dt\ N_i(t) = \int_{<t_{1/2}>}^{\infty} dt\ N_i(t) \qquad (2)$$

for a given mortality law of group *i*. Analytic expressions, particularly in asymptotic regimes, could surely be obtained by further examination of Eq. (1), and warrants further study. Here we solve eq.(2) numerically.

Besides calculating eq.(2), we check our expression from Ref. 1, where the value of $\bar{t}_{1/2}$ was given by

$$N\left(\bar{t}_{\frac{1}{2}}\right) = \frac{1}{2}\ N(t_P). \qquad (3)$$

The area estimate, eq.(2), gives values of $<t_{1/2}>$ that are 20-30% smaller than the number estimate for $\bar{t}_{1/2}$, eq.(3) when applied to men of Trump's and Biden's ages, The meaning of these measures are discussed in more detail in the next section.

Fig. 2 shows results of the simple survival probability calculations for Presidents Trump and Biden, as if there were an ensemble of Trump's and Biden's each of whom suffer the range of

mortalities shown in Fig. 1. With this implausibility being understood, there is a 71% chance that Trump and 62% chance that Biden will live another 5 years. The survival probability is given by

$$P_s(t_P.t_N) = N(t_P + t_N)/N(t_P) \quad , (4)$$

where $N(t_P)$ is calculated from eq. (1), t_N= *5* yrs, and t_P is a person's current age.

In terms of remaining years of life, there is a 50% probability that US males of Trump's current age will live another 8.5 yrs, and a 50% probability that US males of Biden's current age will live another 6.6 yrs. A corresponding calculation for RFK, Jr. is also shown.

A 2x2 death matrix for the 5-yr survival probabilities allows 4 outcomes: (1) DJT dies, Biden doesn't, with a probability p =(1- 0.71)x0.62 ≈ 18%; (2) DJT lives, Biden dies, p ≈ 27%; (3) Both live at least 5 more years, p ≈ 44%; (4) Both die within 5 years, p ≈ 11%.

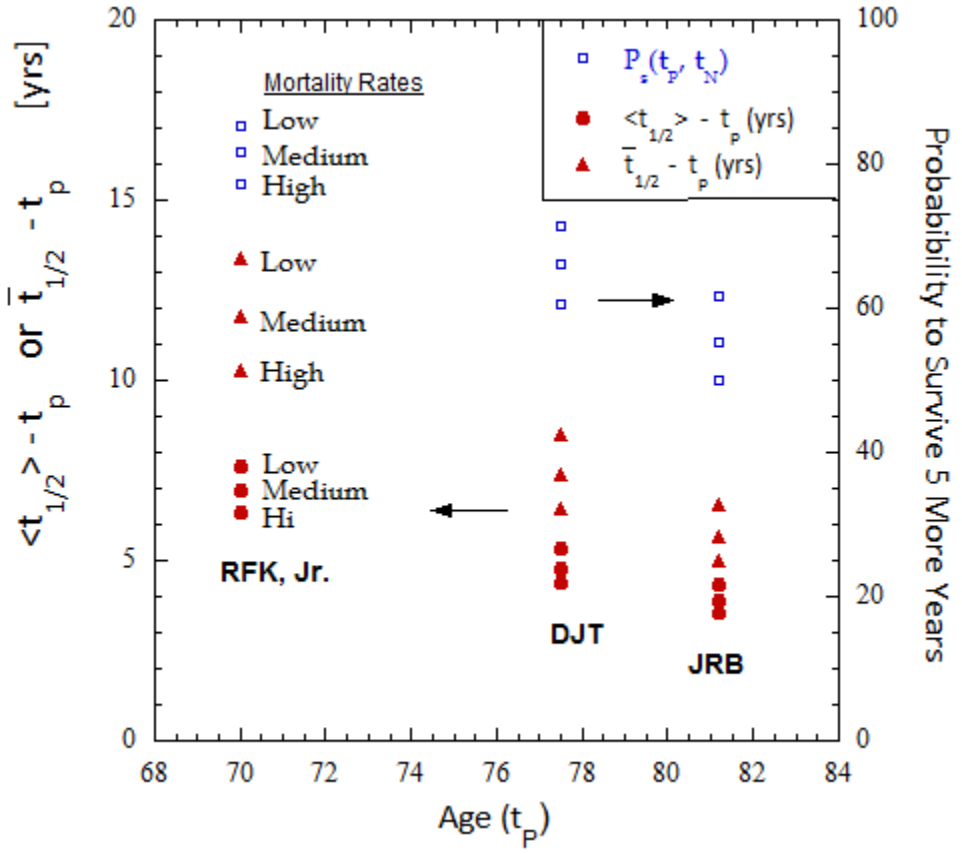

Figure 2. (left axis, filled red diamonds): The number of years remaining, given by eq.(3), for 50% survival of US male cohort population with ages of Trump (DJT), Biden (JRB), and Robert Kennedy, Jr. (RFK, Jr.] that suffer the range of mortalities shown in Fig. 1. (left axis, filled red circles): The number of years remaining, given by eq.(2), until the age cohort has lived 50% of its remaining life. (right axis, open blue squares points): Five-year ($t_N = 5$ yrs) survival probability, eq. (4), for US male cohort populations with ages equal to the current age (at the time of this writing) of Trump and Biden, and RFK, Jr.

Discussion

The advanced age of the current leadership class in the US is cause for concern, so it is of some interest to know the likelihood that the dominant personalities in contemporary US political discourse—Donald Trump and Joseph Biden—will beat the odds of dying. The results of this exercise give a 44% chance that both men will be with us for the next 5 years, and a smaller, 11% chance that they will both have died. There is an 18% chance that Trump will die in the next five years but Biden will not, and a 27% chance that Biden will die but Trump will not.

This estimate was based on the unreasonable, even preposterous assumption that these two men suffer mortality corresponding to the US male average. By virtue of being or having been presidents, Trump and Biden access world-class health-care, which purportedly extends life. On the other hand, presidents' lives are reportedly stressful, which can however have either a deleterious or tonic (cf. Teddy Roosevelt) effect on health. Furthermore, presidents, being in the public eye, are subject to assassination far out of proportion to their number (4 successful assassinations out of 45 presidents, not counting Grover Cleveland twice), with assassination attempts ranging from the tragic-heroic (TR, again, running for the Bull Moose Party in 1912) to the farcical (Squeaky Fromme's attempt on Gerald R. Ford in 1975) to the sobering (attempt on Reagan in 1981).

In summary, It looks like there's a pretty good chance we'll have Trump and/or Biden for the next 5 years. Put another way, these calculations say it's 89% odds that either Trump or Biden will be with us for the next 5 years, with 71% odds that Trump lives for the next 5 years and 62% odds that Biden lives for the next 5 years.

Finally, it's worth saying a few more words about the two techniques used to determine the age $\langle t_{1/2} \rangle$ and $\bar{t}_{1/2}$ for 50% survival probability of a person with current age t_P. Visualized in terms of an age cohort, the equal-areas technique, eq.(2), gives the average number of years during which 50% of the cohort's remaining years are lived. The second technique, eq.(3), gives the age $\bar{t}_{1/2}$ at which the number of members in the age cohort falls to 50% of its original value. So, hypothetically, if the mortality rate is small between 60 and 100 years of age, but large at > 100 yrs, then $\langle t_{1/2} \rangle$ = 80 yrs and $\bar{t}_{1/2}$ = 100 yrs for a 60 yo person.

Because mortality rises so rapidly with age, and there are so few of the very elderly, most of ones' lives are lived in the years before one's age cohort has died out. If there is a lesson from this study, I suppose it is that most of your years together are found when most of your friends are still alive, that is, now. If you wait until your generation has started dying off, you've probably waited too long.

Conclusions

Keeping in mind the complicating factor of migration (see App. B), the mortality rates derived from the temporally-evolving population profiles reveal important information about the health, well-being, and pathologies of a society.

The mortality rates for the purest profiles, that is, those uncorrupted by tampering or data error, represent “natural” causes of mortality, e.g., degenerative disease, sepsis, pneumonia, organ failure, Alzheimer’s, etc., as well as “unnatural” causes, namely homicide, suicide and war.

The old-age mortality simplifies by having a universal origin, probably genetic, as witness the similarity of old-age mortality rates in different countries.[1] For this reason, old-age mortality is probability dominated by “natural” causes, though even these mortality rates could be affected by diet or the environment. My hypothesis for old-age mortality is telomere shortening.[1]

It being the case that both Trump and Biden are mortal, the present calculation seems warranted. For good or ill, this study suggests rather better than even odds that we shall likely enjoy the company of at least one if not both of these elderly gentlemen for some years to come.

A similar calculation for RFK, Jr. (born January 17, 1954, age 70.0), gives a probability of 85% to survive the next 5 years, with the 50% survival ages for a 70 yo person being 77.6 yrs using survival times, and 83.4 yr for survival numbers. How one would fold Kennedy’s family history into his Bayesian priors I leave to the US intelligence agencies to determine.

Finally, we note that the estimates were based on low male US mortality, as might be expected for fit elderly men. Fig. 2 shows the range of survival ages and probabilities for the fits to the male mortalities shown in Fig.1. In this regard, these predictions for survival might be considered optimistic.

Acknowledgements

I thank Prof. Richard Cawthon of the University of Utah for an e-mail correspondence.

References

[1]Dermer, C., Telomeres and the Statistical Mechanics of Mortality, (2023) pdf

[2]Dermer, C., Spike in Hungarian Mortality Rates from Chernobyl? (2023) pdf

[3]Dermer, C., Population Profiles and the Ukrainian Death Spiral. (2024) pdf

[4]Rao. P, 2023 Charted: Average Years Left to Live by Age. link

[5]PopulationPyramid.net: Population Pyramids of the World from 1950 to 2100, link

[6]Migrant Encounters into the US, FY 2023, from CBP and DHS data link

Appendix A. Survival Probability of the Very Old

Calculations are shown in Fig. A1 for the survival probability to advanced age for the different male mortality rates given in Table 1. The low mortality rate gives the highest survival probability. According to these rates, the longest living male of the one-half of the 10^{10} human beings who have ever lived would be about 115.

Given the interest in the question of the longest living human, it would be useful to perform calculations for female mortality rates, for different national mortality rates, and to examine the impact that a flattening of the mortality curves above 90 yo would have on the likely age of the oldest living human.

Fig. A1 shows that there is about a 0.1% chance to live to 100 yo, and a nearly 1% chance with low mortality. This differs from the estimate that about 1 per 6000 Americans was over the age of 100 in 2010.[1] This can be resolved by recognizing that the current census reflects the complex history of evolving mortalities, birthrates, and migration, whereas the survival probability is the likelihood for a random individual to reach age *t*.

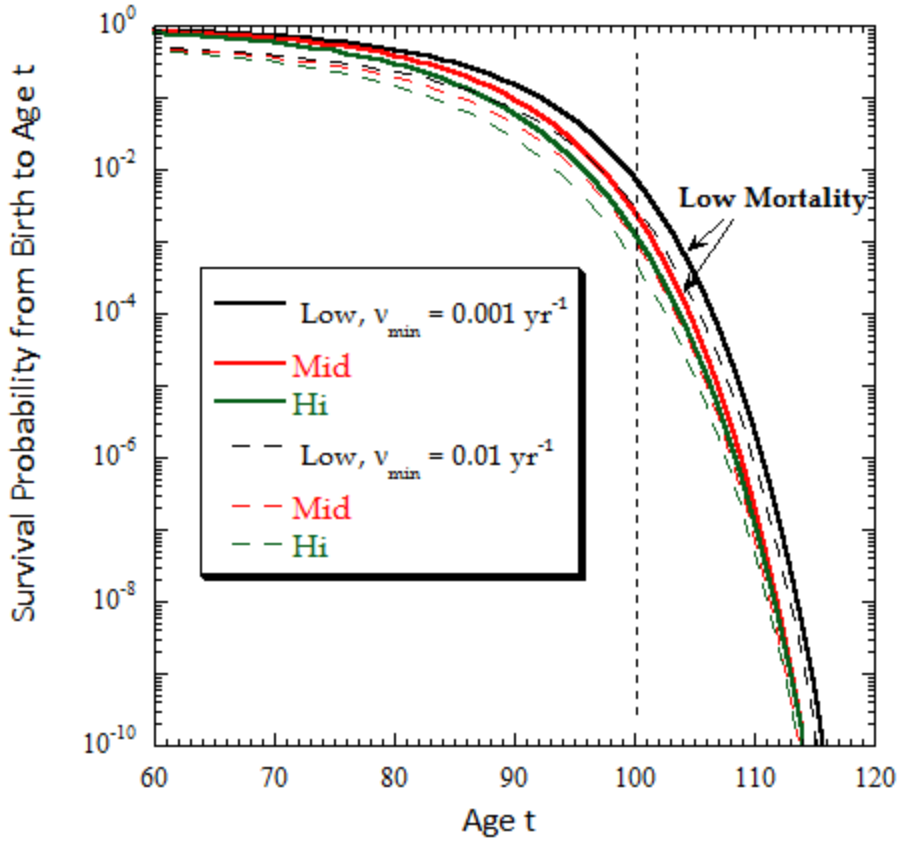

Figure A1. Survival probability to age t. Light and heavy curves show results for background mortalities of ν_{min} = 0.01 yr^{-1} and ν_{min} = 0.001 yr^{-1}, respectively. Male mortality rates from Table 1 are shown by the black, red, and green curves for low medium, and high mortalities, respectively.

Appendix B. US Population and Annual Percentage Growth Rate

Interesting information is revealed by the time derivative of population data. The squares in Fig. 3 are US population data[5] from 1950 to the present, and the projected population from the present to 2030. The year-on-year fractional increases in population are shown by the triangles.

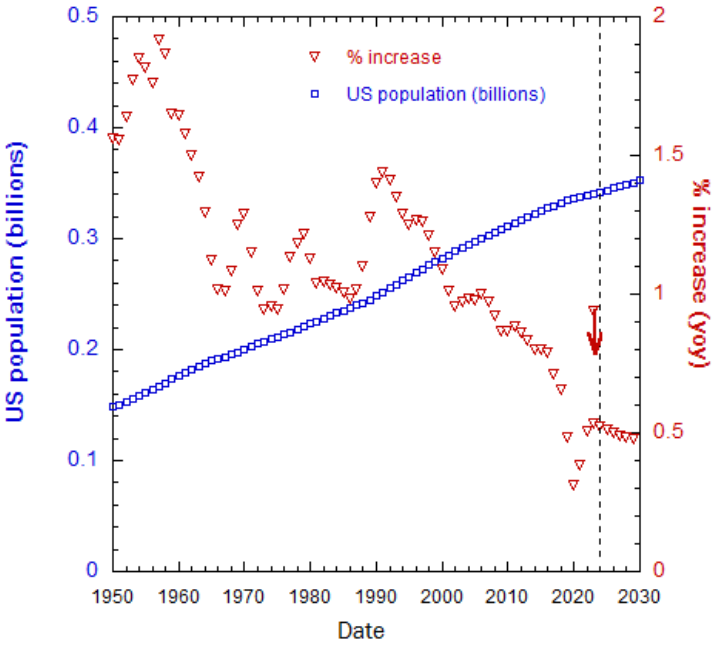

Figure 3. US population and annual percentage Change (APC) of population with time, including UN projections. Upper limit for FY2023 relates encounters with the immigrant arrival numbers (see text).

It's not straightforward to read the APC variations, as they track a tricky convolution of domestic fertility, variable mortality, and inbound migration (minus the small outbound migration). One thing that the API might suggest is that the 1950's peak is due to Mexican migrant labor, followed by Eisenhower's repatriation program. The peak in the late 1980's could be due to the Reagan amnesty followed by subsequent amnesty restrictions, which fell off a cliff during the Trump years (due also to the pandemic).

But this would mean that migrant labor fertility would considerably dominate domestic fertility, which does not seem plausible until perhaps recently. More likely, the baby boom was winding down in the fertility-lowering wake of the '60s sexual revolution (although this seems counter-intuitive), and the 1990's peak was the boomlet of the baby boom.

The upper limit shown at the current epoch represents the population increase due to the current[6] unrestricted immigration surge, assuming that each of the 3.2 million encounters reported by the Customs and Border Protection during FY2023 corresponds to an equal addition or less to the US population.

Recall the strong dependence of doubling t_d on the year-over-year percentage increase A. For reference, A = 0.5%/t_d =139 yrs,1.0%/ 69.7 yrs, 1.5% / 46.5 yrs; 2.0% / 35.0 yrs; 3.0% /23.4 yrs; 4.0% / 17.7yrs.