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Comparative Mortality and Risk Factors for Death among US Supreme Court Justices (1789-2013)

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Objectives.—To compare the mortality experience of 112 justices of the US Supreme Court with that expected in the general population. To identify variables associated with mortality within this cohort.

Background.—Supreme Court justices are a select occupational cohort. High socio-economic status, advanced education, lifetime appointment, and the healthy worker effect suggest lower mortality. Sedentary work, stress, and a tendency to work beyond typical retirement age may attenuate this.

Methods.—Standardized mortality ratios compare the observed mortality rates of justices with those expected in age- and sex-matched contemporary general populations. Poisson regression analyzes variables associated with mortality within the cohort.

Results.—From 1789 to 2013, 112 justices (108 male) contributed 2,355 person-years of exposure. Mean age (standard deviation) at appointment was 53.1 years (6.7); at retirement 69.7 years (9.9); at death (n = 100) 74.4 years (10.3); and at end of the study for those alive (n = 12) 72.1 years (11.8). Standardized mortality ratios (95% ci) were: overall 0.87 (0.70-1.05); prior to 1950 0.92 (0.61-1.33); and from 1950 to 2013 0.66 (0.42-0.99). Variables in the final Poisson model and their associated mortality rate ratios (95% ci) were: age 1.06 (1.03-1.09); calendar year 0.99 (0.99-1.00); active status 0.41 (0.25-0.68); career length 1.04 (1.01-1.07); and chief justice 1.08 (0.59-1.84).

Conclusions.—Supreme Court mortality was lower than that of the general population in the period from 1950 to the present, but was on par prior to 1950. Increasing age and career length were associated with greater mortality, while active status and later calendar year with lower. These results may add to a body of knowledge that may help to develop or refine models of mortality risk in increasingly aged working populations.

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INTRODUCTION

The Supreme Court of the United States (SCOTUS) today comprises 9 members with lifetime appointments.[1,2] Nominated by the President of the United States and confirmed by the United States Senate, Justices of the Supreme Court (JSC) are appointed through a highly selective process that has created a well-defined and rare occupational cohort. JSC nominees are typically legal scholars and high-ranking federal judges, often with significant experience as corporate council or private-practice attorneys. The level of achievement and experience necessary to be considered qualified for the Supreme Court ensures that appointees do not start their careers in their youth, and usually not until around age 50 years. Justices have largely been white, male, well-educated, highly experienced, politically connected, and affluent. All else being equal, their high levels of education and socio-economic status should grant JSC lower age-specific mortality rates than controls from the general population matched on age, sex, and calendar year.

The healthy worker effect (HWE) is the name given to a unique set of biases that are often seen in epidemiological studies of occupational cohorts. The HWE includes two key components: the selection of healthy workers into the workforce (healthy worker selection effect) and the selection of unhealthy workers out of the workforce (healthy worker survivor effect).[3] The net effect in occupational mortality studies is to bias death rates downward, as the healthiest members of a population tend to preferentially obtain and retain jobs in the industry under study. The selection effect may be particularly pronounced here because of the typically late-life selection of JSC; only the most robust of attorneys and judges make it far enough in life and their careers to be considered for the job. If indeed the HWE operates among JSC, then this too predicts lower age-specific mortality rates than that of matched controls from the general population.

However, JSC is not an occupation demanding physical activity, and even if justices make a concerted effort to exercise they still spend significant time being sedentary, a known risk factor for the metabolic syndrome and in turn cardiovascular disease.[4] Furthermore, the gravity of cases the Court reviews and the far-reaching consequences of its decisions could generate significant stress, a risk factor for hypertension and cardiovascular disease. If stress does have a negative effect on longevity among justices, the effect may be related to career length, and may be most pronounced for chief justices, who act not only as a JSC but have additional public duties as the highest judicial officer in the nation. So while demographics and the HWE may provide some advantages with regard to longevity for JSC, the nature of their work may attenuate or eliminate those advantages.

Previous analyses of the mortality of Supreme Court justices have focused on mortality as a competing risk for retirement.[5,6] Studies on the impact of retirement from other occupations on mortality and life expectancy have reported mixed results: some a protective effect of retirement, others the opposite, and others no effect.[6] One analysis of the Supreme Court in particular concluded that mortality is increased by retirement from the court.[7] The demands and prestige of the job of JSC, as well as partisan political issues, may be such that justices tend to stay in their positions longer than might be the case in other professions. Continuing to serve in spite of declining health, were it to occur, would presumably have a negative impact on survival, and thus longer career length may be a marker for increased mortality risk. Alternately, there may be some survival benefit to staying active and continuing to work into advanced ages (part of the HWE); in this case very long career length may be a marker for lower mortality risk. In either case, retirement would be a marker for increased mortality risk, and we seek to explore these hypotheses here, controlling for age and other potentially confounding factors.

An additional factor that must be accounted for is the long duration of observation. The court itself has been continually operating since 1789, making the observation period for the justices span more than two centuries. During this time, mortality rates have declined dramatically for the general population,[8] so we hypothesize the same for the JSC.

Using the biographical data on JSC appointed since 1789 and followed through the end of 2013, we compare the mortality rates of the JSC to those of the general population matched on age, sex, and calendar year using standardized mortality ratios (SMRs). To test hypotheses about the effects of age, calendar year, career length, retirement, and status as Chief Justice on mortality rates among JSC, we model mortality using Poisson regression. Together these analyses provide a complete picture of the comparative and absolute risks of death among Supreme Court justices over the last 224 years.

METHODS

Study Cohort

The study cohort consisted of the 112 US Supreme Court justices appointed between the initial formulation of the court in 1789 and the most recent appointment in 2010, with follow-up through December 31, 2013. Because there have only been 4 female JSC – all of whom were still living as of the end of 2013 – we do not report results separately by gender. Similarly, since there have only been two non-white, male justices (Thurgood Marshall and Clarence Thomas), we use mortality rates for all races combined (which are most representative of whites in the United States) for general population comparisons.

Data on the JSC (name, date of birth, date of death, dates entering and leaving office) were obtained from several sources of publicly available information. The main source was the Supreme Court Historical Society, a non-profit organization founded by Chief Justice Warren E. Burger and dedicated to the collection and preservation of the history of the Supreme Court.[9] Further information was drawn from the Oyez Project – a multimedia archive devoted to the Supreme Court and its work.[10] Any minor discrepancies between the two sources or residual missing data were resolved using book biographies, public records, articles, and websites as needed.

General Population Mortality Rates

Decennial general population mortality rates for US males and females were determined using 3 sources. Rates for 1790 through 1900 were taken from life tables published as part of a recent study by Hacker.[11] Rates for 1900 to 1929 were from life tables provided by the United States Department of Commerce.[12] Rates for 1930 to 2013 were taken from the Human Mortality Database[13], a joint project of the University of California at Berkeley and the Max Planck Institute for Demographic Research in Germany.[13]

Standardized Mortality Ratios

SMRs are a standardized measure of comparative mortality, which divides the observed number of deaths in a study population by the number expected under indirect standardization to general population mortality rates.[14] In brief, the steps in computing SMRs were the following:

1. Observed numbers of deaths were determined for all justices by gender, within 5-year age groups, and within each decade or partial decade from 1789 to 2013.
2. Exposure time for each justice within each age group and decade was determined based on each justice's date of appointment to the court and the end of follow-up. End of follow-up was the latter of either a justice's date of death or the end of the study period, December 31, 2013. Exposure time was then summed across justices within each age group and decade.
3. General population mortality rates for the reference populations were determined for each gender, 5-year age group,

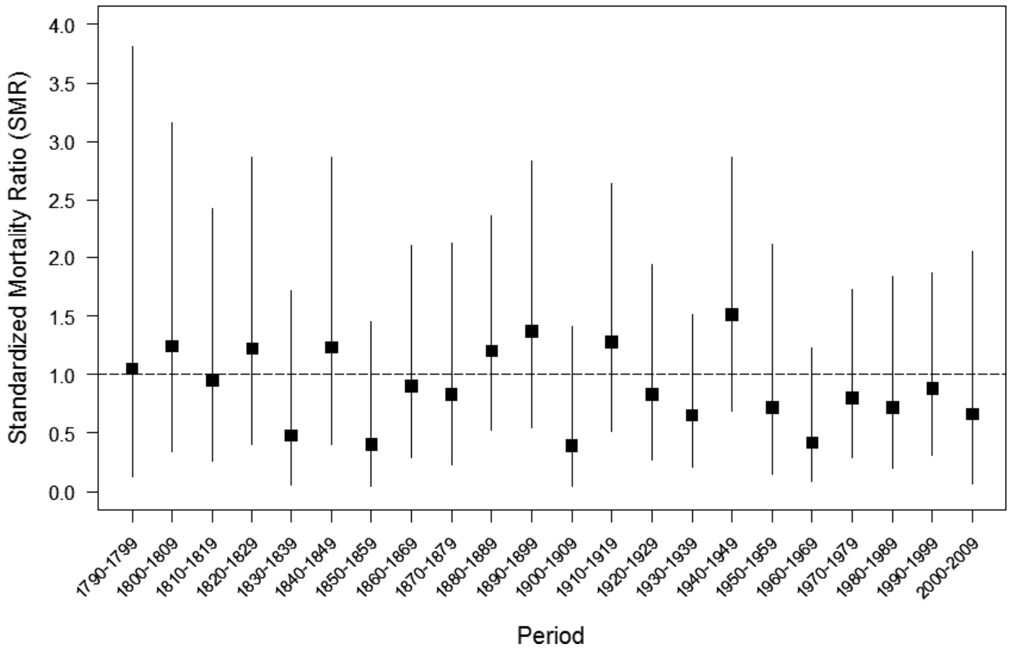

Figure. *Standardized mortality ratios by decade, 1790-2009. Squares represent the point estimates, and the vertical lines are the 95% confidence bands.*

and decade from the appropriate calendar year mortality rate datasets.

4. Expected numbers of deaths for each age and decade were determined by multiplying the mortality rates determined in step 3 by the exposure times determined in step 2. The resulting numbers of deaths were then summed by decade without regard to gender or age.
5. Standardized mortality ratios (SMRs) were determined by dividing the observed numbers of deaths (step 1) by the corresponding expected numbers (step 4).
6. Confidence intervals for the SMRs were determined at the 95% level of confidence based on the assumption that the observed numbers of deaths follow a Poisson distribution.[14]
7. Data processing and statistical analyses were performed using R (R Core Team, Vienna, Austria) and Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA).

Poisson Regression

Poisson regression models are one family of generalized linear models that assume that the count of observed events (eg, deaths) within a given period of time and for a given set of parameters follows a Poisson distribution with mean parameter lambda, the parameter depending on the covariates. The model estimates the natural logarithm of this parameter as a linear function of observed covariates. Poisson models can also take account of the amount of follow-up time attached to each observation; in so doing we can model the rate of death, ie, the mortality rate. The result of this modeling is a set of parameter estimates that can be converted to mortality rate ratios, similar in interpretation to relative risks or hazard ratios.[14]

To model the risk factors related to the mortality rate among the justices, we fit Poisson regression models to the SCOTUS data. We tested parameters for calendar year, career length, active vs retired status, and an indicator of chief justice status, while controlling for age as a potential confounder. We also fit interaction effects between model parameters to test for effect modification. Hypothesis tests were conducted with an alpha level of 0.05.

RESULTS

There have been 112 justices appointed to the Supreme Court since 1789. The mean age at appointment was 53.1 years, with a standard deviation of 6.7 years. The mean age at retirement was 69.7 years, with a standard deviation of 9.9 years. The mean age at death (for those who died) was 74.4 years, with a standard deviation of 10.3 years, and the mean age at study close for the 12 living members was 72.1 years, with a standard deviation of 11.8 years.

The Figure gives the SMRs and 95% confidence intervals for decades between 1790 and 2009. The dashed horizontal line represents unity; any confidence interval that crosses this line fails to achieve statistical significance at the 5% level. The Figure shows that between 1790 and 1949 the SMRs are centered on 1.0, with most point estimates falling in the range of 0.50 to 1.50. Starting in 1950-1959, however, the SMRs are consistently below 1.0, and range from a low of 0.49 to a high of 0.86. In spite of this more consistent pattern in the latter decades, none of the SMR point estimates was statistically significant at the 5% level.

Table 1 shows the justice-years of follow-up over time, the observed and expected deaths, and the SMRs and 95% confidence intervals in several broad periods. The overall SMR for the entire follow-up period (1789 to 2013) was 0.87 (0.70-1.05). The SMR for the period 1789 to 1899 was 0.98 (0.72-1.30), while that of the period spanning 1900 to 2013 was 0.78 (0.58-1.02). Further dividing the post-1900 period into two sub-periods shows that the SMR between 1900 and 1949 remained approximately the same as the 1789-1899 period, at 0.92 (0.61-1.33). However, in the period 1950-2013, the point value of the SMR was appreciably smaller, at 0.66 (0.42-0.99). Only the SMR for 1950-2013 was statistically significant at the pre-determined alpha-level of 5%. All other confidence interval estimates included 1.0, and thus were not considered statistically significantly different than 1.0 at the 5% level.

Table 1. Follow-Up Times, Deaths, and Standardized Mortality Ratios for US Supreme Court Justices, 1789-2013.

Period	Justice-Years	O*	E*	SMR†	(95% CI)†
1789-1899	1027.3	48	48.9	0.98	(0.72-1.30)
1900-2013	1327.8	52	66.6	0.78	(0.58-1.02)
1900-1949	557.6	28	30.3	0.92	(0.61-1.33)
1950-2013	770.2	24	36.3	0.66	(0.42-0.99)
1789-2013	2355.1	100	115.5	0.87	(0.70-1.05)

* O = Observed deaths; E = Expected deaths
† Standardized mortality ratio (O/E) and its 95% confidence interval

Table 2 displays the MRRs and 95% confidence intervals from the Poisson regression models. Table 2 presents crude models for each of the listed factors as well as an adjusted multivariate model. The mortality rate ratios for each of the model terms estimate the

Table 2. Poisson Regression Models for Mortality Among US Supreme Court Justices, 1789-2013.

	Crude			Adjusted†		
Parameter	MRR	(95% CI)	p-value	MRR	(95% CI)	p-value
Age*	1.08	(1.07-1.10)	<0.0001	1.06	(1.03-1.09)	0.0002
Calendar year*	1.00	(1.00-1.00)	0.2410	0.99	(0.99-1.00)	0.0002
Career length*	1.06	(1.04-1.09)	<0.0001	1.04	(1.01-1.07)	0.0033
Active	0.40	(0.24-0.65)	0.0003	0.41	(0.25-0.68)	0.0004
Chief Justice	1.11	(0.62-1.87)	0.6980	1.08	(0.59-1.84)	0.7843

* Risk per each additional year; † Adjusted for all factors in table.

relative risk for a one unit change in that variable, when all other variables in the model are held constant. The crude models show age, career length, and active service to be significantly associated with mortality risk, while calendar year and being chief justice are not. The adjusted model retains these variables, but also reveals calendar year to be significantly associated with mortality risk. Integer age is highly significant in the adjusted model, with each additional year of age increasing mortality risk by 6% (MRR = 1.06, p=0.0002). Each additional calendar year decreases mortality risk by 1%, also a highly significant effect in the adjusted model (MRR = 0.99, p=0.0002). Being an active member of the court (ie, not yet having retired) reduces mortality risk by 59% (MRR = 0.41, p=0.0004). Conversely, this means that retirees from the court are at more than double the mortality risk (1/0.414 = 2.41) of active members, all else being equal. In the adjusted model career length was estimated to increase mortality risk by 4% per additional year served, again a highly significant result (MRR = 1.04, p=0.0033). As in the crude model, being chief justice is not a significant predictor of mortality in the adjusted model (MRR = 1.08, p=0.7843). Interactions between variables were explored and found to be statistically and practically insignificant.

DISCUSSION

A major finding of this study is that, in spite of favorable demographics and the potential for the HWE within the SCOTUS occupational cohort, JSC have displayed significantly lower mortality than the US general population only relatively recently (1950 onward). This is evident in the SMRs before 1950, none of which was significantly lower than 1.0, either when calculated for individual decades or for longer periods. After 1950 however, the point estimates of the decennial SMRs are consistently below 1.0, and the overall SMR for that period is statistically significant.

As with any measure of relative risk, SMRs depend on the selection of the comparison population. A priori, a more appropriate comparison group for the JSC may be other initially healthy working and insured people, such as those whose mortality rates are found in the Valuation Basic Tables (VBT). This would control for the HWE by providing a baseline population that is also healthy enough to work. Unfortunately, in this study the use of such tables is complicated by the long time period over which the cohort extends. We note that the SMRs in Table 2 are all lower than 1.00, but only one of them (1950-2013) is statistically significant. Using VBT-equivalent rates (were such rates available during this historic period) or some other healthy-worker mortality rates as baseline would, of course, result in somewhat higher SMRs, and would likely not achieve statistical significance in any event.

Low statistical power is the chief limitation of the SMR analysis. Because there are only 9 JSC at any given time, and because mortality rates are relatively low until older ages, there are few deaths per decade. With only this small amount of data available in each decade, it is unlikely that any decade-specific SMR would reach statistical significance.

Unsurprisingly, the Poisson model revealed that with increasing age comes increasing mortality risk. The model also suggests that mortality at all ages has declined by about 1% per year on average since 1789. Both of these results are similar to trends in the general population.[11-13]

More surprising are the effects of career length and active service on mortality risk. For a given age, calendar year, and retirement status (active or retired), a one-year increase in career length is associated with a 4% increase in mortality risk. However, remaining active on the Court is protective against mortality, reducing risk by 59%, all else being equal. That length of career was found to have a significant negative impact on survival and may in part reflect the gravity of the stress associated with the job combined with political pressures that may periodically discourage retirement when it would otherwise be considered. For example, if a justice originally nominated by a Democratic president were to be inclined to retire (due to declining health, or other personal reasons) during the term of a Republican president (or vice versa), political pressure may make that decision problematic. This has almost certainly occurred throughout the history of the United States.

The increase in mortality risk after retirement agrees with the results from a previous study of Supreme Court justices.[7] We do not, however, assume causality in the relationship, but instead recognize the dual possibilities that in some cases retirement before death may be merely a marker of declining health, but in others may contribute causally to increased mortality; both seem plausible.

A concern about the full model presented in Table 2 is the possible effect of multicollinearity among the age, calendar year, and career length variables. Each of these measures the passage of time, and thus each may be a surrogate for aging. Table 2 shows that the individual effects are significant in the respective reduced models and that their MRRs are attenuated in the full model. This suggests that each of the variables is contributing something independently of the others. Stratified analyses (not reported here) also demonstrated the effect of career length to be independent of that of age, providing further support for the independent contributions of these time-related variables to overall mortality risk of the JSC.

One way to improve this study would be to obtain detailed cause of death information for all deceased justices. Unfortunately these data likely do not exist, owing to a lack of medical sophistication in the 19th Century as well as a dearth of historical recordkeeping on this topic. Though this information might be available for deaths in the last 50 years or so, such analyses would likely be underpowered to reveal any significant differences in risk by specific causes of death.

Research involving high courts in other settings may shed further light on these findings. The Supreme Court of Canada, for example, has some similarities with the US Supreme Court, with the lifetime appointment of 9 justices. There are differences as well, with Canada requiring representation on the court from various provinces. A comparison of mortality within the two settings may be enlightening. Other countries have term limits for justices, and a comparison with such cohorts may provide clues to the retirement and career-length effects we have found here.

While the results here are, of course, largely historical, they may have some implications for current and future life insurance underwriting. As increasing numbers of working adults remain in the workforce past the traditional age of retirement, new models of mortality risk will be needed to accurately price insurance products for them. The patterns of risk in the JSC could serve as a useful guide in developing and refining risk models for such working populations. In particular, the results here suggest that positive implications for mortality risk of remaining in the workforce may be offset to some extent by longer career length. The results here are at least suggestive of some give and take in this regard.

Justices of the Supreme Court of the United States are a select occupational group. In examining more than two centuries of follow-up data for this cohort, we found little evidence of a protective effect on mortality risk prior to 1950, and significant evidence of such an effect after 1950. As time passes and data accumulate, the point estimate of this protective effect will undoubtedly be modified and the confidence limits narrowed. Is the effect simply the healthy worker effect typical of white collar workers in the modern era? Or is it tempered in this cohort due to extreme pressures unique to the occupation? The significant negative impact of career length on survival suggests it may be the latter. Time and further research will tell.

REFERENCES

1. U.S. Constitution, article III.
2. Nichols P. ''Nine, of course'': A dialogue on Congressional power to set by statute the number of justices on the Supreme Court. *NY Journal of Law & Liberty.* 2006;2:86–130.
3. Checkoway H, Pearce N, Kreibel D. *Research Methods in Occupational Epidemiology.* 2nd ed. New York: Oxford University Press; 2004.
4. Lakaa TA, Laaksonen DE, Lakka H, et al. Sedentary lifestyle, poor cardiorespiratory fitness, and the metabolic syndrome. *Med Sci Sports Exerc.* 2003;35:1279-1286.
5. Zorn CJW, Van Winkle SR. A competing risks model of Supreme Court justices. *Political Behavior*. 2000;22:145–166.
6. Stolzenberg RM, Lindgren J. Retirement and death in office of US Supreme Court justices. *Demography*. 2010;47:269–298.
7. Stolzenberg RM. Do not go gentle into that good night: the effect of retirement on subsequent mortality of US Supreme Court justices, 1801–2006. *Demography.* 2011;48:1317–1346.
8. University of California at Berkeley (USA) and Max Planck Institute for Demographic Research (Germany). Human mortality database. Available at www.mortality.org.
9. Supreme Court Historical Society. Opperman House, 224 East Capitol Street, Washington, DC, 20003. http://www.supremecourthistory.org/society-info/
10. Oyez Project. IIT Chicago-Kent College of Law. 565 West Adams Street, Chicago, IL, 60661-3691. Available at http://www.oyez.org.
11. Hacker, JD. Decennial life tables for the White population of the United States, 1790-1900. *Historical Methods*. 2010;43:45–79.
12. Hill, JA. United States Life Tables: 1921 to 1931, 1920 to 1929, 1919 to 1921, 1909 to 1911, 1901 to 1910, 1900 to 1902. US Department of Commerce; 1936.
13. University of California at Berkeley (USA) and Max Planck Institute for Demographic Research (Germany). Human mortality database. Available at www.mortality.org.
14. Rosner B. Fundamentals of Biostatistics. 7th ed. Boston: Brooks/Cole, Cengage Learning; 2011.