Session 5B: Prediction from Data
Discussant: Joseph Lu, MPhil, FIA

Presented at the Living to 100 and Beyond Symposium
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Papers Presented:

Data Validation and Measurement of Cohort Mortality among Centenarians in Quebec (Canada) According to Ethnic Origin
Melissa Beaudry-Godin, MS, PhD Candidate
Robert Bourbeau, PhD
Bertrand Desjardins, PhD

Physical and Socioeconomic Characteristics at Young Age as Predictors of Survival to 100: A Study of a New Historical Data Resource (U.S. WWI Draft Cards)
Natalia S. Gavrilova, PhD
Leonid A Gavrilov, PhD

Introduction

The work of these two papers, focusing on mortality or survival of centenarians, falls squarely within the theme of this conference. The first paper by Bourbeau and co-workers deals with the validity of data of people of advanced ages in Quebec, Canada. The second paper, by Gavrilova and Gavrilov, investigates early-life characteristics that associate with higher probability of survival to age 100.

First paper: 'Data validation and measurement of cohort mortality among centenarians in Quebec (Canada) according to place of birth and ethnic origin'

The misreporting of ages at death at advanced ages has reduced the reliability of mortality rates calculated from various data. This research investigates the extent of misreporting of ages of French-Canadian Catholic centenarians born in Quebec between 1870 and 1894 and deceased in Quebec between 1970 and 2004. The authors validated the date of birth on death certificates of these centenarians against information on their baptism certificates.

I congratulate the authors on their detailed and thorough examination of ages at death of centenarians in this report. The results have contributed to our knowledge on the nature of misreporting of ages of centenarians in Quebec.

This study observes that the misreporting of ages is symmetrical with as many people underestimating as there are overestimating their actual ages. This is interesting in the light of the relatively conventional thinking that the very elderly in the United States tend to overestimate their ages and these errors result in underestimating mortality rates at advanced ages.

The authors made various comparisons including:

- Comparison of mortality rates calculated from validated and crude data. They concluded that there is little difference between the results of validated and crude data.
- Comparison of mortality rates of French- and English-Canadians. The results suggest that the mortality rates of English-Canadians are higher.

However, these comparisons are shown without statistical tests. Without statistical tests, it is difficult to reach satisfactory conclusion on the comparisons made. We do not know if the results of comparisons are statistically significant. It would be interesting to see if statistical methods could be employed in this study to further our understanding of advanced age mortality. The authors highlighted the small number of Anglo-Canadians (160 people) in this study, making analysis difficult. An appropriate statistical model might be able to quantify the credibility and reliability of the results.

This study reports a decline in force of mortality at higher ages, which is consistent with other studies in this field. The authors calculate the ceiling of mortality rates of centenarians below age 105 to be around 40 percent, as shown in Figure 2. This is consistent with many studies.

It is worth noting that the work of Gavrilov and Gavrilova presented in this symposium suggests a lack of levelling of mortality rates up to age 105 using data of the United States. Furthermore, when Bourbeau and co-workers split the data of English-Canadian from that of French-Canadian, there is no clear levelling of mortality rates for these two populations. This prompts the question of whether the levelling of mortality rates observed here in the total population is the result of heterogeneity in the population. Below 104, the higher mortality of English-Canadian increases the average mortality rates of the population. After the English-Canadian of the cohorts become 'extinct' after age 105, the mortality rates observed in the total population belong to that of the French-Canadian with lower mortality rates. The combined effect is what appears to be the levelling of mortality rates. (This paragraph is added after the formal discussion.)

The mortality rates here are calculated for people spanning a relatively long period. It involves people born over 25 years between 1870 and 1894. They died between 1970 and 2004, which is a period of 34 years.

Recent international studies have shown profound changes in mortality over the last few decades. For example, deaths relating to circulatory diseases have fallen by 40 percent for Canadian males aged 75+ in the two decades ending in 2000 (WHO data). The fall in total mortality is 20 percent over the same period for the same population. I wonder if the authors could offer us any views on the change in mortality rates of the centenarians in the study over the period of observation. Can I use the Qxs of the centenarians presented in this paper as is? Do I need to make adjustments to them for today's use?

Finally, the authors hinted that they are doing further work on advanced ages using the same dataset. I look forward to their future report. Thank you.

Second paper: 'Physical and socio-economic characteristics at young age as predictors of survival to 100. A study of a new historical data resource (the U.S. WWI draft cards)'

The research of this second paper relates to a question that interests many people: "What is the secret to living to 100?" The authors examined the physical and socio-economic

characteristics at young adulthood that correlate to survival to 100. We could answer this question by investigating a population in a prospective or a retrospective manner.

A prospective method would involve a longitudinal study that follows a cohort, of credible size, through their lives. This means that we follow a generation of people from birth to death, recording their characteristics throughout their lives. Then we analyze the characteristics that associate with people living to 100. However, this method requires a large amount of resources in terms of time, money and expertise. For example, it will require a longitudinal population study. One such dataset is the English Longitudinal Studies on Ageing in the United Kingdom that collect a large range of information necessary to understand the economic, social, psychological and health elements of the aging process. This dataset has 12,000 members aged above 50. However, the researcher would have to wait for at least 50 years to find out the characteristics of people aged 50 today that correlate with living to 100. This is very time consuming.

Fortunately for us, Drs. Gavrilova and Gavrilov took a different path and examined the issue with a retrospective method. Using a randomized matched-case controlled study, they linked 240 centenarians born in 1887 to their data on the newly available online U.S. WWI Civilian Draft Registration Cards with 171 eligible linkages.

They reported that people with ‘stout’ body shape were negatively correlated to living to 100. Having been a farmer or having had more children was positively correlated to survival to 100. Other factors that have been shown to be correlated to mortality such as marital status, height, immigration status and occupation at early life were shown to be statistically insignificant to survival to 100 in this study.

I agree with the authors that this study demonstrates the usefulness of the U.S. WWI draft registration cards. However, the results are based on only 174 male centenarians, who have been successfully linked to the WWI data. With 2,500 male centenarians in the 1887 cohort, it would be desirable to expand this study to a larger number of centenarians. This might help verify some of the results, such as the lack of correlation of socio-economic status at early adulthood to survival to 100. The authors’ observation appears surprising because

there is a relatively large body of evidence showing differences in mortality between different social classes in the United States and other developed countries.

In the Introduction section, the authors set out to test two scientific hypotheses—(A) early-life infection is detrimental to longevity; and (B) rapid catch-up growth is bad for longevity—using body shape as markers of early-life infection and rapid catch-up growth.

The authors suggested if hypothesis of early-life infection (A) is correct, centenarians are expected to be taller. They found that the centenarians are not taller. Does the result conclusively reject this hypothesis? Could it be that body shape, height in this case, is not a good indicator for early infection? There are many factors that could result in differences in height other than early infection. Some examples include nutrition and genetic make-up.

If the hypothesis of rapid catch-up growth (B) is correct, centenarians are expected to be smaller. The authors found that centenarians tend to 'stout,' hence supporting this hypothesis. The authors highlighted the detrimental effect of obesity on longevity.

I congratulate Drs. Gavrilova and Gavrilov on their creative use of recently available data to further our understanding on longevity. I now pass the time to all attendees and look forward to a stimulating discussion.