



SOCIETY OF ACTUARIES
INTERNATIONAL SYMPOSIUM

Mortality Trajectories at Exceptionally High Ages: A Study of Supercentenarians

Natalia S. Gavrilova

NORC at the University of Chicago

Leonid A. Gavrilov

NORC at the University of Chicago; Computer Science and Control Federal Research Center,
Russian Academy of Sciences

Vyacheslav N. Krut'ko

Computer Science and Control Federal Research Center, Russian Academy of Sciences; and Sechenov
First Moscow State Medical University

Presented at the Living to 100 Symposium
Orlando, Fla.
January 4–6, 2017

Copyright © 2017 by the Society of Actuaries.

All rights reserved by the Society of Actuaries. Permission is granted to make brief excerpts for a published review. Permission is also granted to make limited numbers of copies of items in this monograph for personal, internal, classroom or other instructional use, on condition that the foregoing copyright notice is used so as to give reasonable notice of the Society's copyright. This consent for free limited copying without prior consent of the Society does not extend to making copies for general distribution, for advertising or promotional purposes, for inclusion in new collective works or for resale.

Mortality Trajectories at Exceptionally High Ages: A Study of Supercentenarians

Natalia S. Gavrilova,¹ Leonid A. Gavrilov,² Vyacheslav N. Krut'ko³

Abstract

The growing number of persons surviving to age 100 years and beyond raises questions about the shape of mortality trajectories at exceptionally high ages, and this problem may become significant for actuaries in the near future. However, such studies are scarce because of the difficulties in obtaining reliable age estimates at exceptionally high ages. The current view about mortality beyond age 110 years suggests that death rates do not grow with age and are virtually flat. The same assumption is made in the new actuarial VBT tables. In this paper, we test the hypothesis that the mortality of supercentenarians (persons living 110+ years) is constant and does not grow with age, and we analyze mortality trajectories at these exceptionally high ages.

Death records of supercentenarians were taken from the International Database on Longevity (IDL). All ages of supercentenarians in the database were subjected to careful validation. We used IDL records for persons belonging to extinct birth cohorts (born before 1895) since the last deaths in IDL were observed in 2007. We also compared our results based on IDL data with a more contemporary database maintained by the Gerontology Research Group (GRG).

First we attempted to replicate findings by Gampe (2010), who analyzed IDL data and came to the conclusion that “human mortality after age 110 is flat.” We split IDL data into two groups: cohorts born before 1885 and cohorts born in 1885 and later. Hazard rate estimates were conducted using the standard procedure available in Stata software. We found that mortality in both groups grows with age, although in older cohorts, growth was slower compared with more recent cohorts and not statistically significant. Mortality analysis of more numerous 1884–1894 birth cohort with the Akaike goodness-of-fit criterion showed better fit for the Gompertz model than for the exponential model (flat mortality). Mortality analyses with GRG data produced similar results.

The remaining life expectancy for the 1884–1894 birth cohort demonstrates rapid decline with age. This decline is similar to the computer-simulated trajectory expected for the Gompertz model, rather than the extremely slow decline in the case of the exponential model.

These results demonstrate that hazard rates after age 110 years do not stay constant and suggest that mortality deceleration at older ages is not a universal phenomenon. These findings may represent a challenge to the existing theories of aging and longevity, which predict constant mortality in the late stages of life. One possibility for reconciliation of the observed phenomenon and the existing theoretical consideration is a possibility of mortality deceleration and mortality plateau at very high yet unobservable ages.

¹ NORC at the University of Chicago

² NORC at the University of Chicago; Computer Science and Control Federal Research Center, Russian Academy of Sciences.

³ Computer Science and Control Federal Research Center, Russian Academy of Sciences; and Sechenov First Moscow State Medical University.