



Article from

In the Public Interest

September 2016

Issue 13

Living to 100 Section: Socio-Economic Mortality Differentials: An International Perspective

By Kai Kaufhold

“In the midst of life we are in the midst of death, a truer word was never said.”

Thornton Wilder: *The Skin of Our Teeth*, a Play.

As much as we actuaries work with mortality rates in our daily business, calculating probabilities of survivorship and actuarial present values of benefits, it never ceases to baffle me just how little we really know about the drivers of mortality. What do we really know about the ultimate causes of why different groups within society have such varying mortality rates?

Health inequalities by socio-economic status have been the subject of intense study in recent years. In 2005, the World Health Organization launched the Commission on Social Determinants of Health, which produced its report “Closing the Gap in a Generation” in 2008. Since then, similar initiatives have been undertaken at the national level (Strategic Review of Health Inequalities in England post 2010¹) and Europe-wide (European Review of Social Determinants of Health and the Health Divide for WHO Euro). Premature death and higher prevalence of illness in lower socio-economic groups have been linked to a number of different drivers of mortality and morbidity, such as limited access to health care, less awareness of healthy behaviors and healthy nutrition, and the individuals’ disadvantaged living and working conditions. These factors in turn are closely correlated with the level of education, the wealth of an individual and the person’s social context.

The socio-economic differences between different parts of the general population are commonly accepted as the reason why mortality of insured lives observed within the insurance industry is lower, on average, than the mortality of the general population. In a recent study,² Louis Adam of Université Laval in Canada showed the difference between general population mortality, the mortality rates in Canadian social security pensions (Canada Pension Plan and Québec Pension Plan), and defined-benefit (DB) pension plan mortality. However, the differences do not stop there: within DB pension plans there is a difference between public sector plans and pension plans spon-

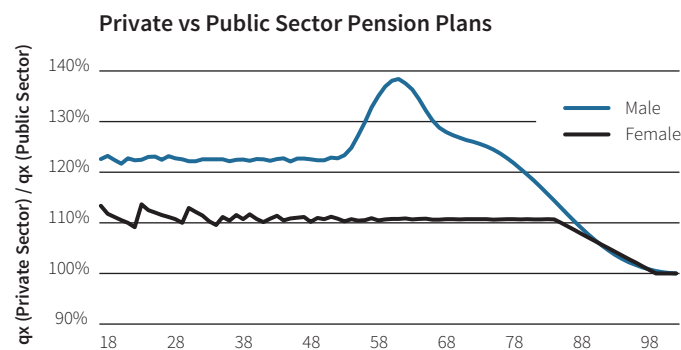
sored by private companies, as shown in Figure 1. At retirement age, male mortality within private sector pension plans is up to 38 percent higher than mortality for male pensioners within the public sector. We can only surmise that the socio-economic cross-section of government employees must be different from the composition of the private sector workforce, leading to this significant difference in mortality experience.

Within any single DB pension plan, we also commonly observe a disparity of mortality rates which corresponds to the different socio-economic levels of the different employee groups. Figure 2 shows the ratio between the observed number of deaths and the expected deaths calculated from a simple age-gender model and shown across pension size, for a group of U.K. pensioners. The group comprising the 5 percent of pensioners with the largest pension amounts has only 60 percent of the mortality of all other pensioners. This is, in itself, already remarkable, but becomes all the more relevant when we consider that this group represents more than 40 percent of the total annual pension benefits.

Such a concentration of benefits within a small group presents a two-fold challenge for the actuarial practitioner. For one thing, the group with the largest financial impact also has the longest survivorship, which is a strain on the funding of the pension plan. In addition, this particular group with a disproportionate share of benefits is relatively small with little experience data. Therefore, sophisticated modeling techniques are needed to properly estimate the mortality assumptions and measure the estimation error at the same time.

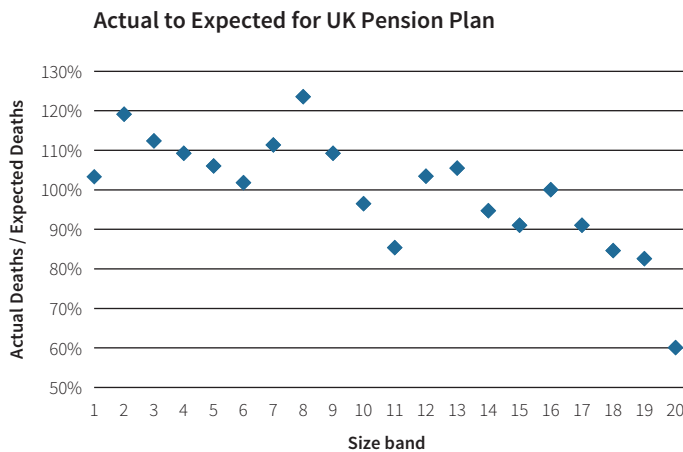
One would be forgiven for thinking that such inequality is specific to certain industries, such as manufacturers or mining companies, where there is a large disparity between the majority of workers and a small number of managers. However, we observe

Figure 1: Comparison of mortality for private sector and public sector pension plans in Canada.



Source: Canadian Institute of Actuaries, Canadian Pensioners’ Mortality Report, February 2014, Document 214013t1e-1.

Figure 2: Mortality of a typical UK Pension Scheme.



Source: Sample data from longevity.co.uk representing a typical U.K. pension scheme, generated using a model fitted to U.K. pensioner data. Expected deaths are calculated using a Makeham-Perks model fitted with age and gender as the only risk factors. The size bands are created by sorting the pensioners by annual pension amount and subdividing them into 20 quantiles.

such socio-economic differences in mortality even within relatively homogenous groups. Consider a German public sector pension scheme, for example, which we studied in 2013.³ The top 5 percent of pensioners by annual pension amount received around 16 percent of the total benefits, which indicates a lower degree of disparity than in the previous example from the U.K. Nevertheless, this select group displayed mortality rates more than 25 percent lower than the pensioners within the bottom 85 percent of pension amounts. So, even despite being a relatively homogenous group (public sector pensioners) in Germany, a country that prides itself in being egalitarian, there were mortality differentials that had a substantial impact on the overall level of pension liabilities.

Taking this result one step further, we analyzed the mortality of a group of pensioners who one might assume not only to be homogenous with respect to mortality, but also who would be expected to have equal access to excellent health care options: retired medical doctors. In Germany, there are separate mandatory pension plans for certain professions, such as doctors, architects, lawyers or chartered accountants. Since all members of such a pension plan have the same level of education and belong to the same broad socio-economic class, we would expect that their mortality rates would be relatively homogenous, too. Nevertheless, we were able to observe a mortality differential of up to 20 percent between the average and those retired doctors who receive the largest 5 percent of annual pensions. Such a differential can neither be explained by different levels of education nor by the “poorer” doctors not being able to afford proper

health care. It only goes to show that we still do not completely understand the drivers of mortality. Might it simply be that the most successful doctors also are the longest lived, or could it be that those doctors who are aware of their good health have an incentive to make higher contributions to the pension plan? Another possible explanation is that doctors who have longer careers and accumulate greater benefits over a longer period of time tend to be healthier. It is also possible that pension size just happens to be correlated with a different driver of mortality, such as the year-of-birth cohort. Maybe the cohorts of doctors who were able to make the greatest contributions to their pension plans just happen to belong to the year-of-birth cohort with the greatest mortality improvements.⁴ The investigation is still ongoing on this last project, as it is on many different projects which intend to improve our understanding of the drivers of mortality and socio-economic mortality differentials.

Beyond these practical challenges, the wider implications of this phenomenon are perhaps even more important. The fact that wealthier people with a greater share of the pension pot also live longer raises questions of social injustice. A number of countries are already actively considering changes to their social security systems to differentiate retirement age across different groups, giving those individuals with shorter than average life expectancy the chance to retire early and, at the same time, delaying retirement for the higher socio-economic groups. Many questions remain about socio-economic mortality, drivers of mortality and modeling of future mortality. The upcoming Living to 100 Symposium to be held Jan. 4–6, 2017, in Orlando, Fla., will allow you to explore these topic areas and many more. Researchers from different countries will present their findings on trends in death by cause, the drivers of mortality, future mortality trends and socio-economic differences in mortality, and leaders in the biology of aging will present their perspective on the latest research on how to extend the number of healthy years of life. Since 2002, the Living to 100 Symposium has been held every three years, giving researchers the opportunity to present current findings and discuss them with practitioners from the insurance indus-

Socio-economic differences pose a challenge to the actuarial practitioner: The lives with the largest pension benefits and thus the largest financial impact also have the longest survivorship. ...

try and other stakeholders. Enhance your knowledge and join us in learning more about mortality and how to avoid it at the Living to 100 symposium!⁵

You can also find monographs of past symposia with contributions from leading experts in demography, biology, medicine and actuarial science at the Living to 100 website, LivingTo100.soa.org. ■



Kai Kaufhold is managing director of Ad Res, an actuarial consulting firm in Cologne, Germany. He is a member of the organizing committee of the Living to 100 Symposium. As a former life reinsurer, he has been studying longevity and mortality risk for more than two decades.

ENDNOTES

- ¹ The Marmot Review: Fair Society, Healthy Lives. <http://www.instituteofhealthequity.org/projects/fair-society-healthy-lives-the-marmot-review>
- ² Canadian Institute of Actuaries: Final Report – Canadian Pensioners' Mortality, Pension Experience Subcommittee-Research Committee, February 2014.
- ³ Richards, S.J., K. Kaufhold and S. Rosenbusch (2013) Creating portfolio-specific mortality tables: a case study. *European Actuarial Journal*, 2(3), 295-319.
- ⁴ While the cohort effect is not quite as pronounced in Germany as it is in the U.K., it is nevertheless present in general population mortality experience. On the cohort effect see:
- Willets, R.C., A.P. Gallop, P.A. Leandro, J.L.C. Lu, A.S. Macdonald, K.A. Miller, S.J. Richards, N. Robjohns, J.P. Ryan and H.W. Waters, (2004) Longevity in the 21st Century, *British Actuarial Journal* 10, IV, 695 – 898.
- Richards, S.J., J.G. Kirkby, and I.D. Currie (2005). The importance of year of birth in two-dimensional mortality patterns. *British Actuarial Journal* 12, I, 5-61
- ⁵ Registration will soon be available at LivingTo100.soa.org.