



Article from

## **Reinsurance News**

July 2016

Issue 85

# Socio-Economic Mortality Differentials and Concentration Risk

By Kai Kaufhold

Within the life insurance industry there is a strong drive to “Know Your Customer!” and as reinsurers we applaud that. While life insurers may be most interested in the lifetime value of a customer relationship from a marketing perspective, to us reinsurers it is important to be able to accurately assess the risk which an insured life represents. The variability of results within a portfolio is driven by a number of items, including the policy size distribution and the distribution by different risk classes. The more diverse the insured lives are with respect to their mortality risk (or morbidity or disability for that matter), the more widely claims will vary. Therefore, un-

derstanding the key drivers of mortality which explain the differentials in mortality rates between different groups is of great importance to reinsurers.

However, understanding cause and effect of mortality drivers is not an easy task. Take smoking as an example. While the adverse impact on an individual’s health is fairly easy to detect—just listening to a smoker’s cough is a dead give-away—it took us a long time to introduce smoking as a rating factor, and even longer for the legal system to acknowledge the causal relationship, but that’s another matter.

As reinsurers, our motivation for understanding mortality differentials is to be able to assess the risk and adequately price for it, offering discounts for the best risks, but also being able to offer adequate prices for other groups. Society at large is interested in understanding mortality differentials more for the purpose of alleviating the disadvantage of those at greater risk and thereby improving their situation. Our interests are ultimately aligned when it comes to investigating mortality drivers.

Policy size is a risk factor that reinsurers have long known about and include in their pricing. However, policy size itself does not



explain the differences in mortality. We like to explain the observed increased mortality for lower face amount policies with lower socio-economic status, i.e., that these policyholders cannot afford larger policies. However, policy size is not a perfect predictor for socio-economic status and even socio-economic status is not an explanation; it is merely correlated with mortality differentials. The possible reasons are diverse. Thus, research into this phenomenon is warranted.

Socio-economic health inequalities 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, similar initiatives have been undertaken at the national level (Strategic Review of Health Inequalities in England post 2010<sup>1</sup>) 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.

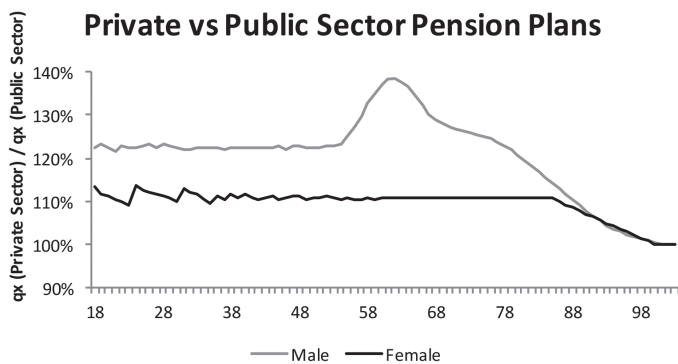
The socio-economic differences between different parts of the general population are commonly accepted as the reason why mortality of insured lives observed within the insurance industry is lower on average than the mortality of the general population. Mortality differentials between different groups of insured lives are well known to reinsurers. These differences also exist within the pensions industry. With a growing interest in longevity reinsurance, understanding this sector should also be of interest to life reinsurers. In a recent study<sup>2</sup>, 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 sponsored 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 that corresponds to the different socio-economic levels of the different employee groups. Figure 2 shows the ratio between the observed number of deaths and expected deaths calculated from a simple age-gender model without pension size, for a group of UK pensioners. The group comprising the 5 percent of pensioners with the largest pension amounts has mortality which is significantly lower than 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.

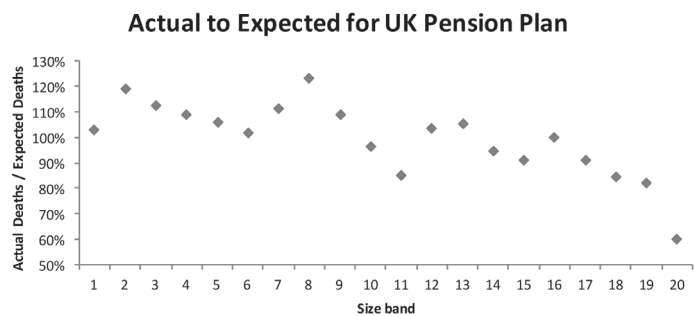
Such a concentration of benefits within a small group is another example of inequality, which is a challenge for the actuarial practitioner. The group with the largest financial impact also has the longest survivorship, which is a strain on the funding of the pension plan. This also poses a risk to any reinsurer offering longevity risk coverage to the pension plan. Therefore, understanding concentration risk is of vital importance to reinsurers.

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 longevitas.co.uk representing a typical U.K. pension scheme, generated using a model fitted to U.K. pensioner data. Expected deaths calculated using a Makeham-Perks model included 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.

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 such socio-economic differences in mortality even within relatively homogenous groups. Take a German public sector pension scheme for example, which we studied in 2013<sup>i</sup>. 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 with the 85 percent smallest 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 whom one would assume not only to be homogenous with respect to mortality, but all of whom we assume have 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 are 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 5 percent largest 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 most aware of their good health have the greatest incentive to make the most contributions to the pension plan? 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 most contributions to their pension plan just happen to belong to the year-of-birth cohort with the greatest mortality improvements.<sup>ii</sup> The investigation is still ongoing on this last project, as it is on many different projects that intend to improve our under-

standing of the drivers of mortality and socio-economic mortality differentials.

Many questions remain about socioeconomic 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 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 industry and other stakeholders. Enhance your knowledge<sup>iii</sup> and join us in learning more about mortality and how to avoid it at the Living to 100 symposium! Coming soon are registration details at [LivingTo100.soa.org](http://LivingTo100.soa.org). ■

#### ENDNOTES

- <sup>1</sup> The Marmot Review: Fair Society, Healthy Lives. <http://www.instituteofhealthequity.org/projects/fair-society-healthy-lives-the-marmot-review>
- <sup>2</sup> Canadian Institute of Actuaries: Final Report – Canadian Pensioners’ Mortality, Pension Experience Subcommittee- Research Committee, February 2014.
- <sup>i</sup> Richards, S.J., K. Kaufhold and S. Rosenbusch (2013) Creating portfolio-specific mortality tables: a case study. *European Actuarial Journal*, 2(3), 295-319.
- <sup>ii</sup> While the cohort effect is not quite as pronounced in Germany as it is in the UK, 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
- <sup>iii</sup> The monographs of past symposia with contributions from leading experts in demography, biology, medicine and actuarial science can be found at [LivingTo100.soa.org](http://LivingTo100.soa.org).



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