Actuaries Institute



Exploring Retiree Mortality

December 2018

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This report was prepared by Rice Warner, on behalf of the Actuaries Institute, and funded by a donation from David Orford.

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1. Executive summary

Rice Warner was engaged, on behalf of the Actuaries Institute, to investigate the mortality of older Australians who hold annuities with the work funded by a donation by David Orford.

The motivation for the work was a desire to better understand the mortality of older Australians who might purchase Comprehensive Income Products in Retirement (CIPRs). These products are being promoted by Government policy[1] and aim to provide better outcomes for retirees by sharing the longevity risk. These products extend beyond traditional life annuities and include Group Self Annuitisation (GSA) products and potentially also forms of annuities that have some features of GSAs.

The aim of the study was to produce a series of mortality tables that would enable product manufacturers to design and price appropriate products that will mitigate the financial risk faced by long lived individuals. The usual method for producing mortality tables such as these is to examine the mortality experience of individuals holding these, or similar, types of products.

These examinations and analyses require large data sets in order to produce statistically credible results. There were potential issues in this regard because the annuity market in Australia is small and many life insurers have withdrawn from the market over the last twenty years. The particular concern was with the credibility of results for the oldest lives.

Our approach to the study was, therefore, to:

- Seek to obtain experience data from all Australian life insurers with portfolios of annuity business both those that are open for new business and those with closed portfolios.
- Seek to obtain experience studies and data from actuaries and others with experience data regarding older, retired Australians.
- Obtain relevant overseas experience and results to assist with the credibility of results, especially for the older ages.

Unfortunately, we were not able to obtain sufficient Australian data to allow for a full development of mortality tables for Australian annuitants. We therefore decided to use data obtained from the Continuous Mortality Investigation (CMI, a subsidiary of the Institute and Faculty of Actuaries in the UK) to examine the features of retiree and annuitant mortality and explore how these insights might be translated to Australian conditions.

Without credible Australian data from which to develop mortality tables, we have sought to provide a method by which the detailed UK results can be translated to the Australian context. We have done this by using population mortality as the point of comparison. We have considered the UK annuitant mortality in relation to the UK population mortality, considered the UK population mortality in comparison to the Australian population mortality, and provided a method to derive indicative mortality rates for Australian annuitants.

1.1 The elements

The UK results comprise two major studies. The first is for the period 2007 to 2010, and the second for the period 2011 to 2014. The 2007-10 series provides detailed graduated mortality tables for voluntary and compulsory purchase annuities as well as extensions to advanced ages – see Section 3.3 (Initial benchmark).

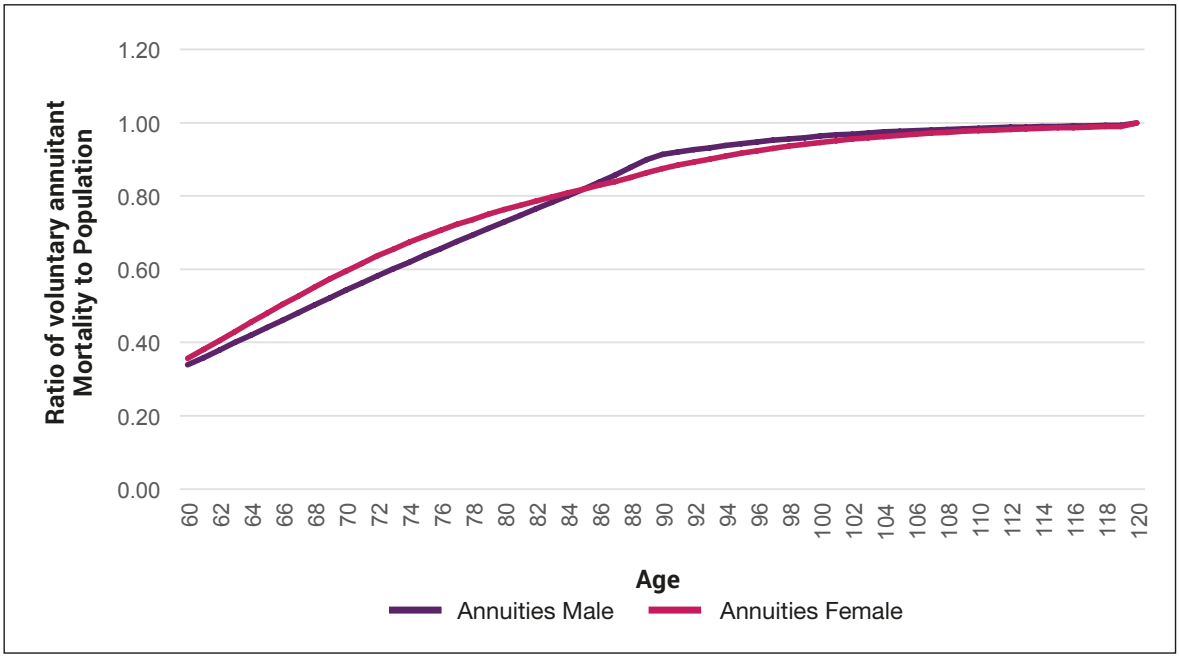
The 2011-14 series provides a much larger and more granular set of data, but only has experience for compulsory purchase annuities and pensions – see Section 3.4 (Mortality rates for 2011-14). The pensions results from this study provide some interesting insight into socio-economic factors – see Section 3.4.6 (Socio-economic factors).

1 See Treasury's Retirement Income Framework initiative: https://treasury.gov.au/programs-and-initiatives-superannuation/retirement-framework/

1.2 Indicative results

There is currently no compulsion in Australia in relation to the purchase of retirement income stream products and it is well recognised that the process of voluntary purchase is highly selective. Selection effects are starkly demonstrated in the UK results. Graph 1 shows the ratio of voluntary annuitant mortality to population mortality and Graph 2 shows the same ratio for retirement annuitant (compulsory purchase) mortality.

Graph 1. Ratio of voluntary annuitant mortality (q_x) to population (UK)

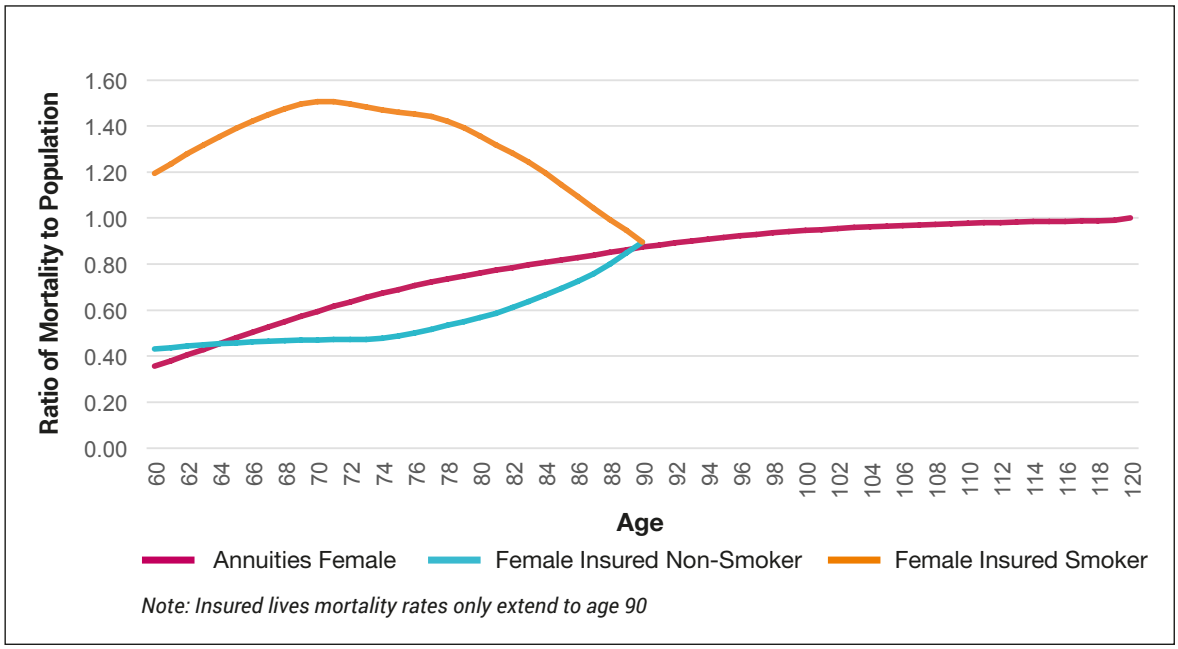


Graph 2. Ratio of retirement annuitant mortality (q_x) to population (UK)



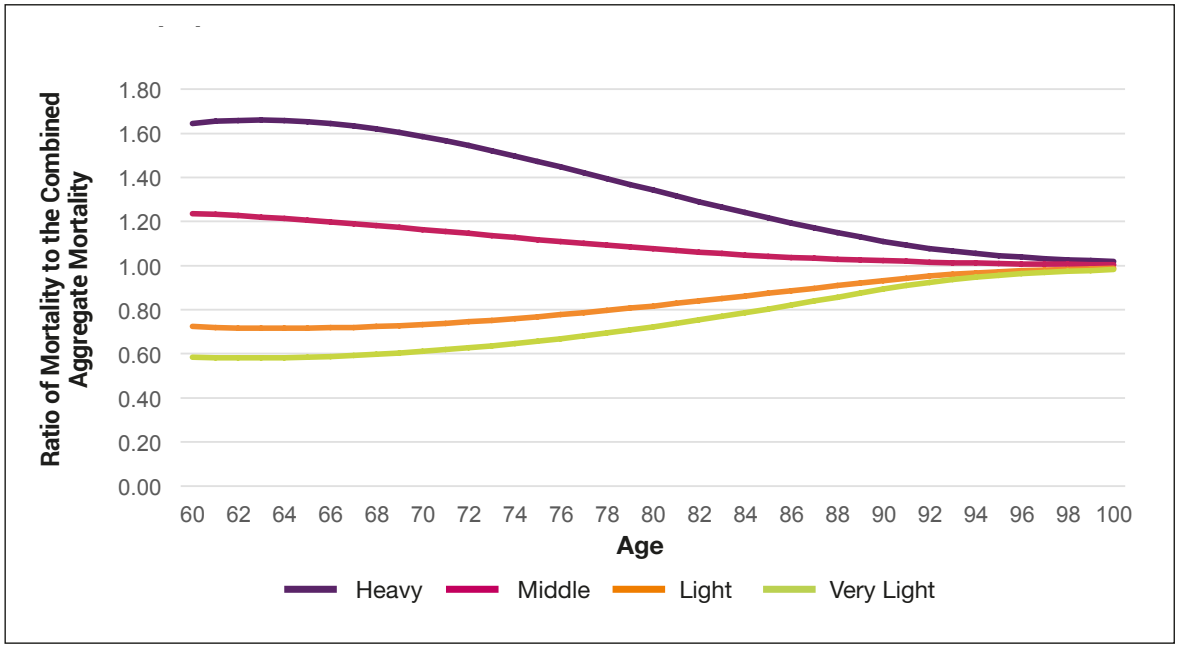
This can also be seen by comparing voluntary purchase annuitant mortality to insured lives mortality. Graph 3 compares ultimate insured lives mortality to voluntary purchase annuitant mortality for females. This shows that the selection inherent in voluntary purchase of an annuity is equivalent to that inherent in life insurance underwriting. It also shows that there is significant scope for better annuity rates for smokers.

Graph 3. Comparison of insured life and voluntary annuitant mortality as ratio of population (q_x) – Females (UK)



The results also show a strong correlation between mortality experience and the amount of pension/annuity being drawn. Those drawing smaller pensions experience much higher mortality. Graph 4 shows this result. The 'Heavy' mortality band is for pensions up to £5,000 per year, 'Middle' for pensions of £5,000 to £20,000 per year, 'Light' for pensions of over £20,000 per year and the 'Very Light' band being for pension amounts over £40,000 per year. The 'Very Light' band is included within the 'Light' band.

Graph 4. Ratio of mortality in each band to the combined aggregate mortality (q_x) – Males (UK)



See Section 3.4.6 (Socio-economic factors) for commentary.

1.3 Australian context

The translation of the UK results to the Australian context is provided in Section 4 (Australian mortality outcomes) with indicative annuitant mortality rates provided in Table 2 for males and Table 3 for females.

A crucial aspect of pricing retirement income products will be the allowance made for future improvements in mortality rates. The analysis we have carried out indicates that the ratio of the mortality of retirement annuitants to population mortality remained much the same between the two UK studies – within statistical variability.

An estimation of the improvement in annuitant mortality rates can be determined by applying the ratios provided in Table 2 and Table 3 to the ALT 2010-12 (as improved either by the factors provided by the Government Actuary or another method).

1.4 Limitations and further work

The results presented in this report are indicative only. They cannot be relied upon for the pricing or valuation of retirement income products. Readers will need to consider the appropriateness of the methodology we have used to their specific circumstances. In particular, readers should consider the appropriateness of these rates for products like GSAs and other mortality pooling products that are quite different in operation from annuities and pensions. Readers should also consider the potential impact of recent changes to Age Pension Means Testing rules, which may impact on the level of selection taking place at the time of purchase of retirement income products.

We unfortunately cannot publish the detailed underlying data from the CMI studies as they are subject to copyright and a license fee. Anyone who wishes to explore the information can contact the CMI directly via their web site: **https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation**

2. Methodology and data

2.1 Data

Rice Warner approached a range of domestic annuity and pension providers with the intention of collecting data on a confidential basis. This approach aimed to pool data from as wide a range of sources as possible in order to develop a pool of data with sufficient size to support the calculation of credible mortality rates.

Unfortunately, only TAL, MLC and Mercer provided data. Whilst helpful, these data sets of Australian annuitant and pensioner experience were insufficient to support the determination of credible mortality tables from first principles.

Our investigation of overseas experience showed that the best developed and most relevant studies were those of the CMI for UK pensioners and annuitants. The CMI kindly agreed to allow us to use their published reports and data in our study. The information provided included:

- Aggregated Exposed to Risk and Deaths data for pensioners and annuitants for products held between 2007 and 2010 for individuals aged 25 to 100.
- Graduated ultimate mortality tables for multiple products for ages 20 through 120 based on data collected from 2007 to 2010.
- Population data from the UK in 3-year intervals from 1980 to 2016 including graduated extrapolations to higher ages to match the annuitant and pensioner tables.
- Aggregated Exposed to Risk and Deaths data for pensioners and annuitants for products held between 2011 and 2014 for individuals aged between 25 and 100.
- Graduated mortality tables for pensioners based on the 2011-2014 data including extrapolation to age 120 and comparison to population mortality.

We therefore decided to use the UK CMI results as a benchmark and to use the Australian data we have been able to obtain to determine how the UK CMI results would need to be adjusted to reflect Australian conditions.

2.2 Methodology and structure

Our approach for determining indicative mortality rates for Australian annuitants was:

1. Use the graduated UK CMI results to determine a comparison of ultimate annuitant and pensioner mortality rates to UK population mortality.
2. Use the aggregated UK CMI data for the 2007 – 2010 and the 2011 - 2014 periods to analyse the impact of selection.
3. Compare the UK CMI and Australian data to determine the relativities between them.
4. Determine a set of mortality rates for Australia based on a ratio to population mortality derived from the UK CMI results.
5. Provide guidance on the use of these rates.

3. UK mortality data and results

Over the period covered by the UK CMI data, the UK had a deep annuitisation market due to a legislative requirement that tax advantaged retirement benefits be compulsorily converted to an annuity or pension. This ensures the credibility of the data but raises the question of applicability to Australian conditions where the purchase of annuities and other longevity protection products is, and will probably remain, voluntary.

3.1 UK annuitants

Interpreting the results from the UK CMI is complicated by the relative complexity of the UK annuity and pension markets and the multiplicity of descriptive terms for the products. We need to distinguish the following products:

Retirement Annuities	These are annuities compulsorily purchased with the proceeds of a pension (superannuation) plan.
Voluntary Annuities	These are personal annuities purchased outside the retirement incomes system. This market is much smaller than the retirement annuity market, so the data is not as robust as for the retirement annuity market but is useful for indicating the effects of selection due to voluntary purchase.
Enhanced Annuities	These are annuities which take into account likely excess mortality due to medical conditions, smoking and lifestyle, and yield higher payment amounts as a result. None of the experience data relates to these products, but their availability provides an indirect method for selection for Retirement Annuities. Those with likely excess mortality will tend to buy Enhanced Annuities and therefore be excluded from the Retirement Annuity mortality pool.
Pensions	These are income streams paid from pension plans where the benefit is simply converted within the plan from accrual to payment. Some of these are provided by the scheme via the purchase of an annuity from a life insurer.

3.2 Overview of data

In conducting this study Rice Warner received the following data and reports:

- Aggregated Exposure and Deaths data for voluntary annuities and retirement annuities for the period 2007 to 2010. The data provides some subdivision according to period since purchase allowing for an estimation of selection effects.
- Annuitant (Retirement and Voluntary) and Pensioner mortality rates applicable to July 1, 2008 derived from data spanning 2007 to 2010. These are referred to as the Series 08 mortality rates and are presented in the CMI Working Paper 81 and related data sets from June 2015. The results cannot be subdivided by product type or by period since purchase.
- This data was used by the CMI High Age Mortality Working Party in its assessment of high age mortality (i.e. above age 100) in conjunction with population mortality for England and Wales as published by the British Office of National Statistics (ONS) for the year 2015 – based on experience from 2014 to 2016. The purpose of the Working Party was to improve the reliability of mortality assessments above age 90 and provide a robust extension to age 120. This work is presented in CMI Working Paper 100 from July 2017.
- Aggregated Exposure and Death data for retirement annuitants and pensioners for the period 2011 to 2014 for individuals aged between 25 and 100. The data set is much larger than that underpinning the Series 08 rates and is subdivided by product type and by period since purchase. The results are published by the CMI's Annuities Committee as CMI Working Paper 101 from July 2017.

3.3 Initial benchmark

The 08 Series mortality tables as extended by the High Age Mortality Working Party is a useful benchmark. The original data set yielded credible graduated mortality rates up to approximately age 90. The careful and detailed extension of these rates to age 120 in combination with equivalent work in respect of the population mortality table has provided a reliable estimate to these older ages. It has importantly also provided a comparison to population mortality.

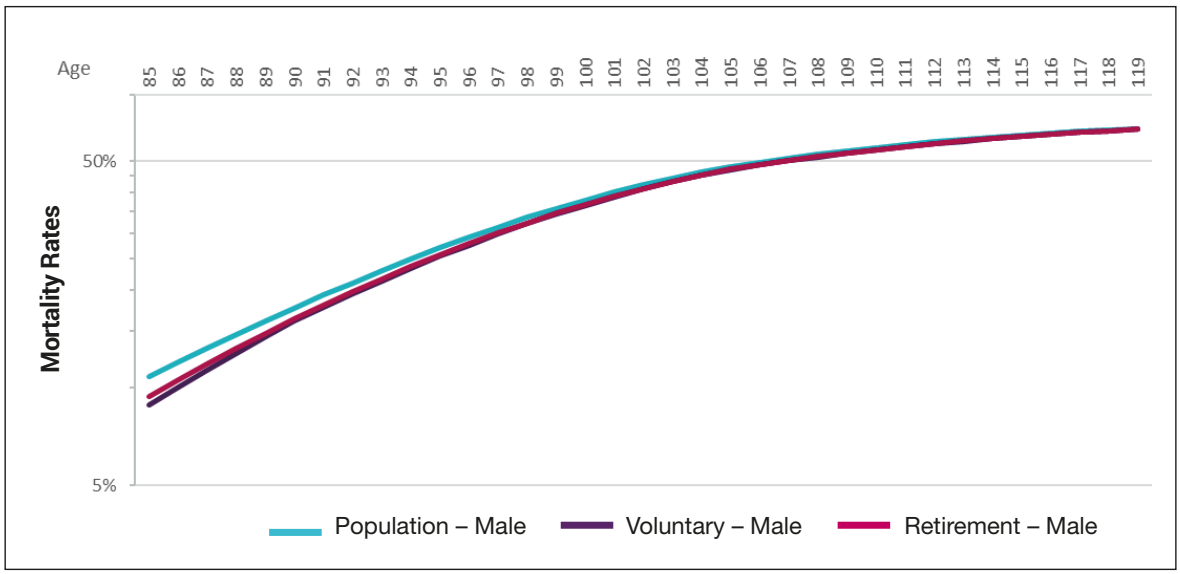
3.3.1 Mortality rates

Graphs 5 to Graph 8 show the 08 Series extended and graduated mortality rates for Voluntary and Retirement annuitants for males and females respectively in comparison to the extended 2015 population table. The graphs are presented on logarithmic scales and are split at age 85.

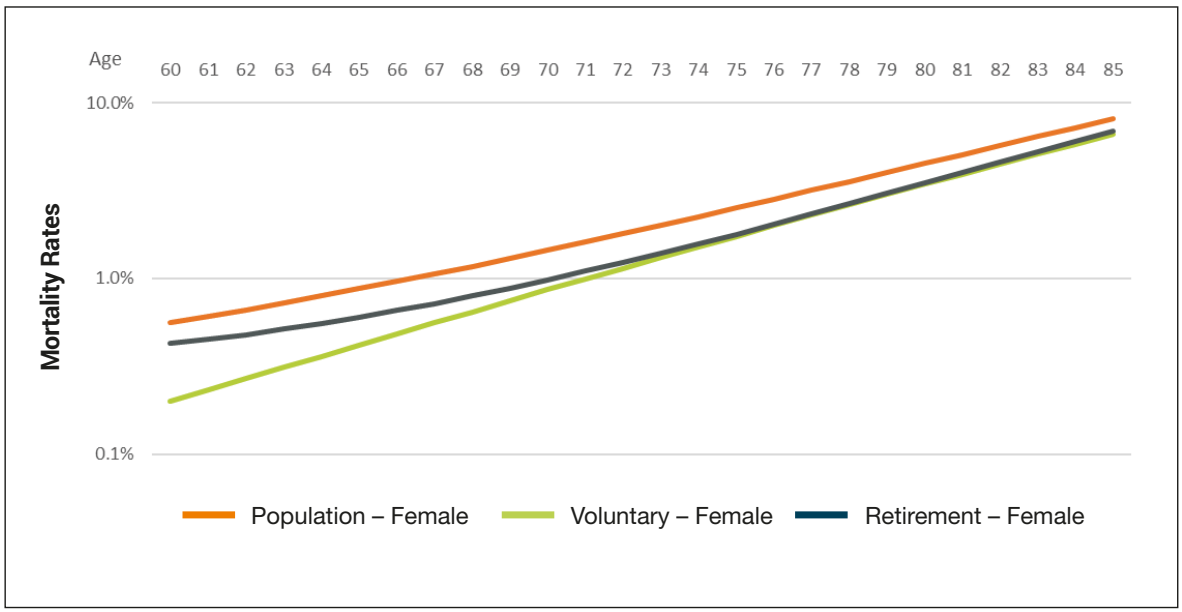
Graph 5. Mortality rates (q_x), male, ages 60 through 85 – Population, voluntary and retirement annuitants (UK)



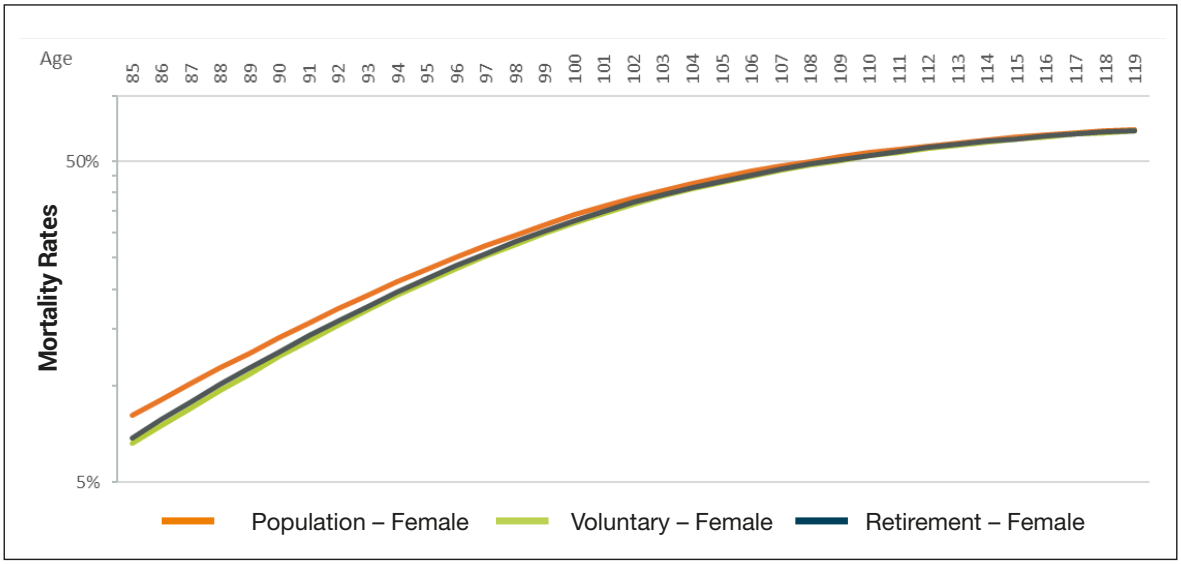
Graph 6. Mortality rates (q_x), male, ages 85 through 119 – Population, voluntary and retirement annuitants (UK)



Graph 7. Mortality rates (q_x), female, ages 60 through 85 – Population, voluntary and retirement annuitants (UK)



Graph 8. Mortality rates (q_x), female, ages 60 through 85 – Population, voluntary and retirement annuitants (UK)

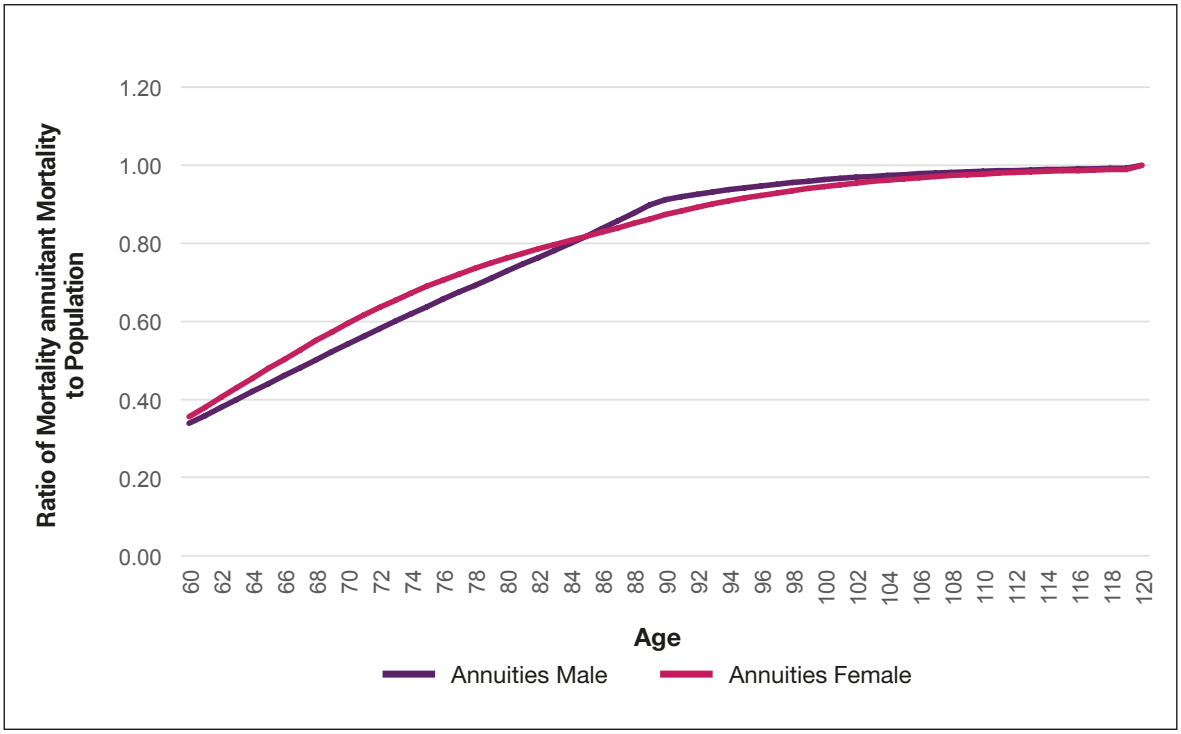


For both men and women:

- Voluntary and Retirement annuitant mortality is lower than that for the population at all ages.
- At the younger ages, which are predominantly the ages at which annuities are purchased, Retirement mortality is noticeably higher than Voluntary mortality. The difference demonstrates the selective effect of voluntary purchase.

These effects can be better seen by considering the ratio of graduated and extended Voluntary and Retirement annuitant mortality to population mortality. Graph 9 shows the comparison for voluntary annuitants and Graph 10 shows the comparison for retirement annuitants.

Graph 9. Ratio of voluntary annuitant mortality (q_x) to population (UK)



Graph 10. Ratio of retirement annuitant mortality (q_x) to population (UK)



Voluntary annuitant mortality is markedly lower than population mortality up to approximately age 90. This is undoubtedly due to the selection effect from voluntary purchase at these ages.

The results for purchasers of Retirement annuity products are more complex. Retirement annuity mortality is noticeably higher than voluntary annuitant mortality in ages below 75, but there is still evidence of a selection effect.
Possible reasons for this are:

- Whilst compelled to purchase an annuity, purchasers were able to 'shop around'. Enhanced Annuities which provide higher yields for substandard lives were available to purchasers during this period so some of those who could obtain a better return from such an annuity would have tended to do so. This higher mortality group would, therefore, have been removed from the sample.
- The extent of this selection would be lower than that for voluntary purchase as only a proportion of the retiring population would have sought out Enhanced Annuities.
- Providers of pension funds generally sought to encourage their retirees to keep their pension/annuity with the provider.
- The retirement annuitant pool contains reversionary pensioners as well as those who have retired. The impact of reversionary pensioners is highest at the youngest ages where they are a greater proportion of the data set. This impact is diluted from age 65 when the bulk of retirements occur.

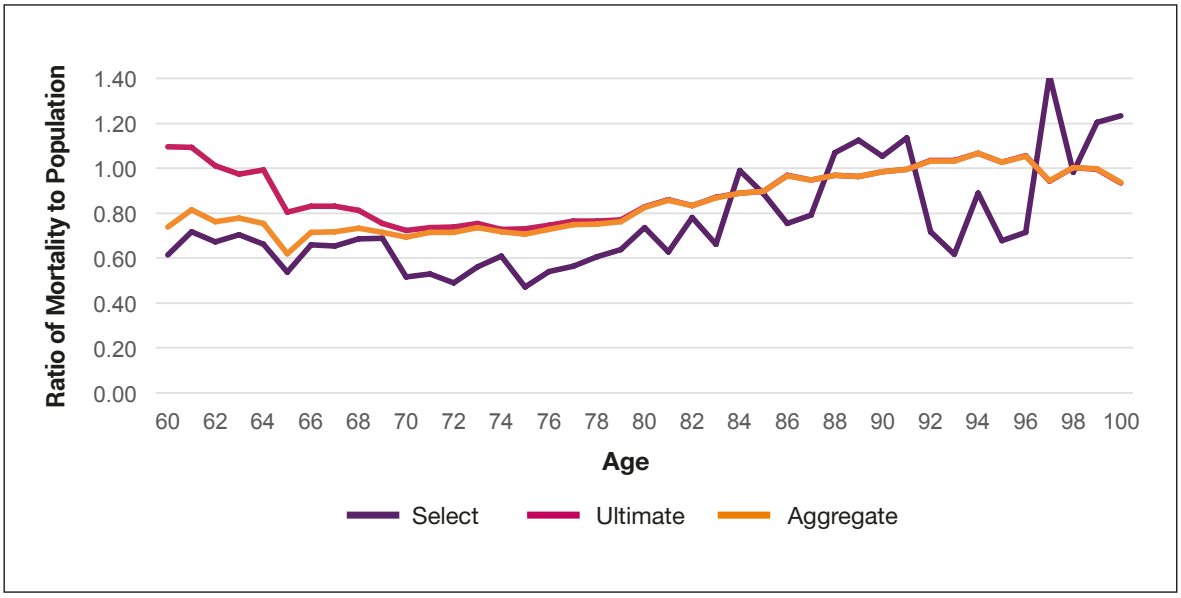
The impact of selection for female lives is essentially the same as for male lives (relative to base mortality rates).

3.3.2 Impact of selection

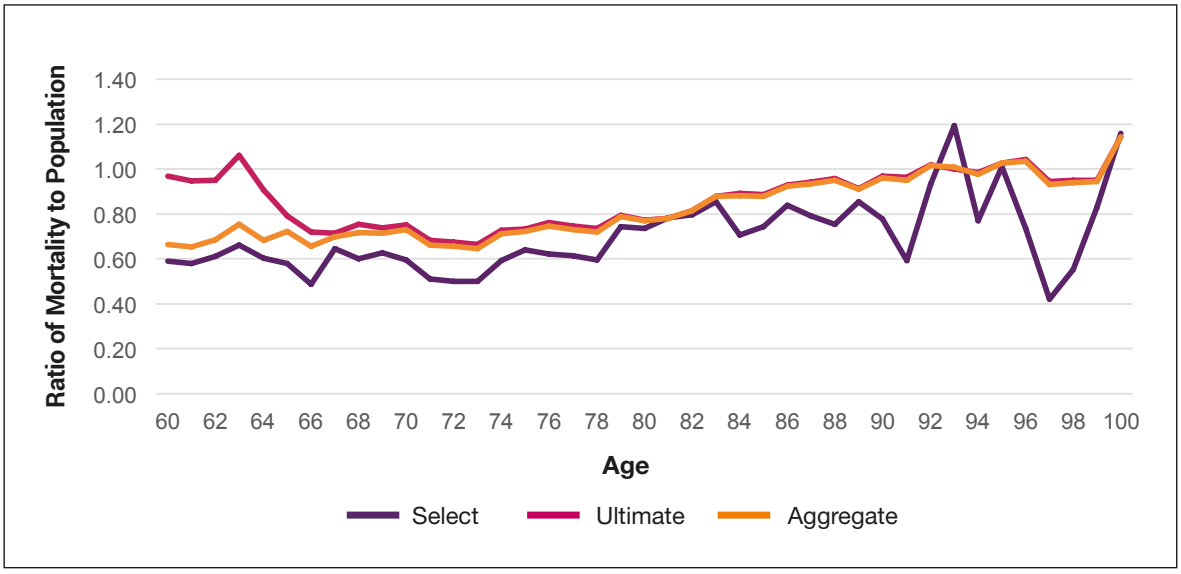
The data underpinning the 08 Series graduated tables does provide a view as to the level of selection for the retirement annuities. Selection presents itself as a difference in mortality experience for recent purchasers as compared to long term holders (the ultimate experience). Graph 11 shows the ratio of male mortality to population mortality for a select period of 5 years – i.e. purchase within the last 5 years. Graph 12 shows the equivalent ratios for female lives.

These graphs are based on raw, ungraduated mortality rates, but, nonetheless, show the impact of selection. This impact is only important up to approximately 70 because there are very few annuities purchased above age 70. The Select mortality rates are not reliable above age 70 because exposures above this age are markedly lower than below age 70.

Graph 11. Males ratio of select and ultimate mortality to population – 5 year select period (UK)



Graph 12. Females ratio of select and ultimate mortality to population– 5 year select period (UK)

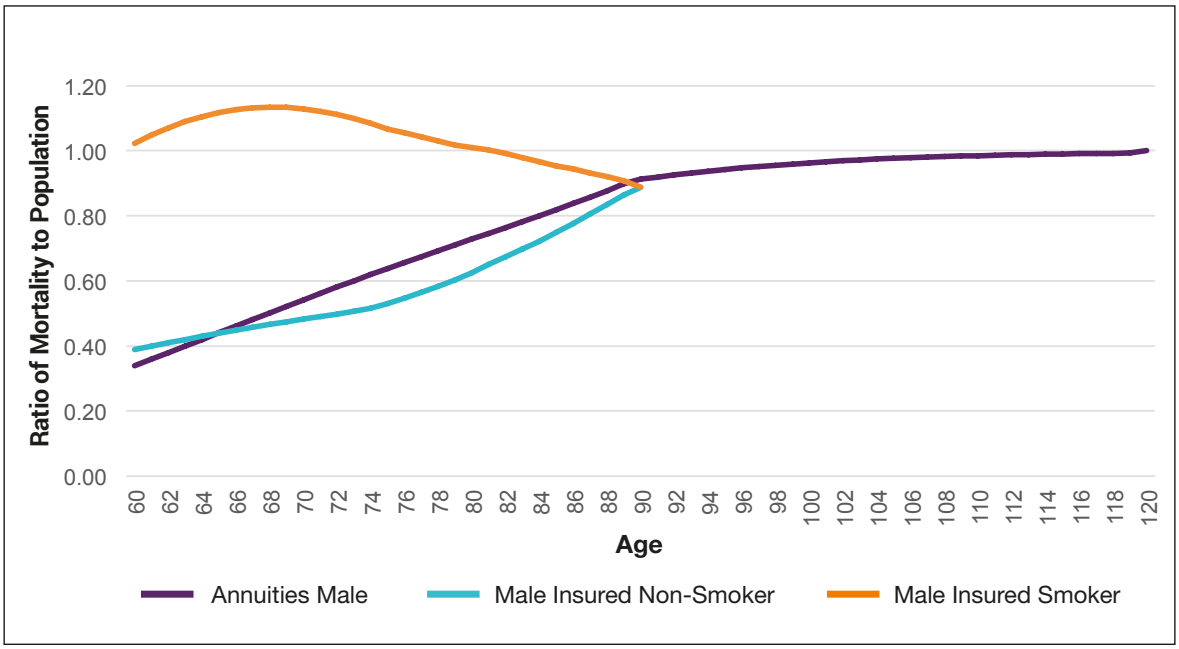


These two graphs show that the impact of selection is important but is significantly less than the selection demonstrated by voluntary purchase. The aggregate mortality experience at age 60 for voluntary purchase is approximately 40% of population (Graph 9) whereas the select experience for compulsory purchase (as shown here) is approximately 60% of population.

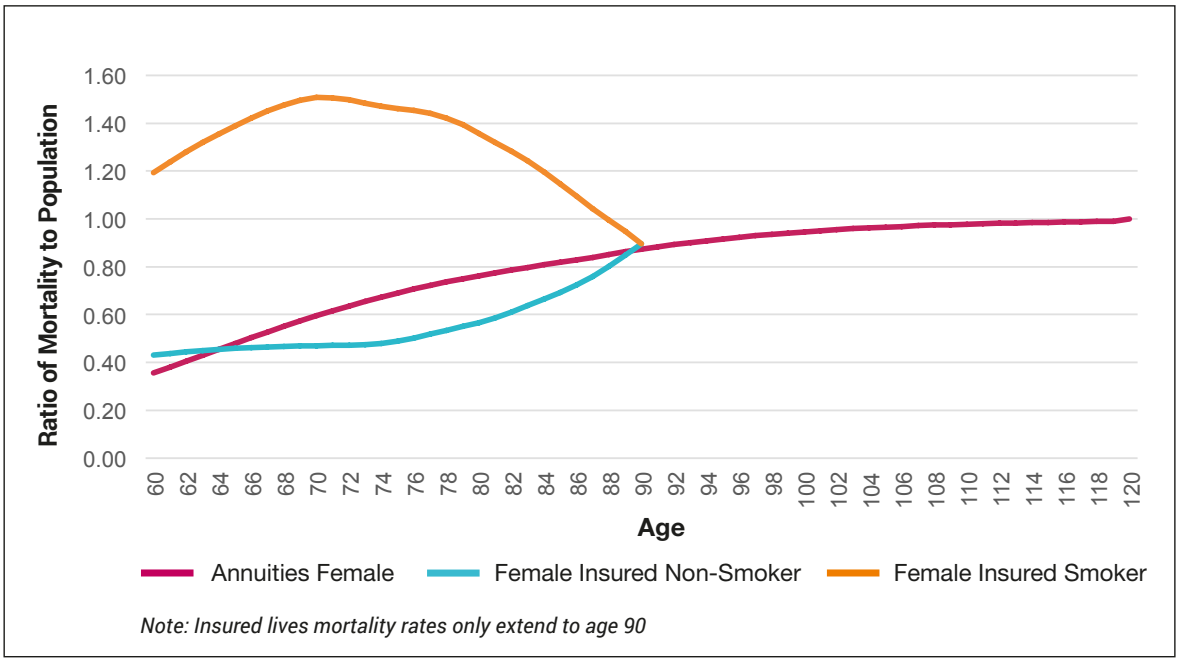
3.3.3 Comparison to insured lives

The 08 Series also contained an assessment of the mortality of insured lives. This mortality is not directly relevant to the mortality of annuitants, but a comparison between the mortality of voluntary purchase annuitants and insured lives provides an assessment of the level of self-selection that occurs via voluntary purchase. The following graphs show the insured life graduated ultimate mortality rates as a ratio of the graduated and extended population mortality rates of the 08 Series in comparison to the ratio for voluntary purchase annuities.

Graph 13. Comparison of insured life and voluntary annuitant mortality as ratio of population (q_x) – Males (UK)



Graph 14. Comparison of insured life and voluntary annuitant mortality as ratio of population (q_x) – Females (UK)



The select period for the insured lives analysis was 5 years. The mortality experience for the annuitants is the aggregate experience which did not take account of years in force.

These graphs show that the mortality experience of voluntary purchase annuitants is only slightly higher than the ultimate mortality experience of non-smoking lives insured. This indicates that the process of voluntary purchase is significantly selective with aggregate experience being similar to that for underwritten non-smokers.

The graphs also show that there is significant scope for better annuity rates for smokers.

3.4 Mortality rates for period 2011-2014

The results for this period are presented in the Annuity Committee's Working Paper 101 (CMI101) dated July 2017. The data set comprises pension (i.e. retirement) annuities in payment as submitted by insurance companies. In comparison to the 08 Series as presented above, the data set:

- Does not provide data on voluntary purchase, life annuities.
- Allows analysis by product type. The two broad categories are Individual annuities (which are purchased by individuals using their retirement benefit) and Pension buy-out annuities (which are purchased by pension schemes on behalf of members). The terms 'Individual' and 'Pension' are used to distinguish the two groups.
- Does not include pensions provided by self-administered pension plans.
- Does not include Enhanced Annuities.
- Is considerably larger, with over 60% more deaths. There are 7,133,273 exposure years and 174,158 deaths for Individual annuities and 1,273,874 exposure years and 50,339 deaths for Pension annuities.
- Allows analysis of experience by distribution channel for Individual annuities. In particular, the difference in experience between those who simply took the annuity offered by their provider and those who purchased the annuity via an external channel.

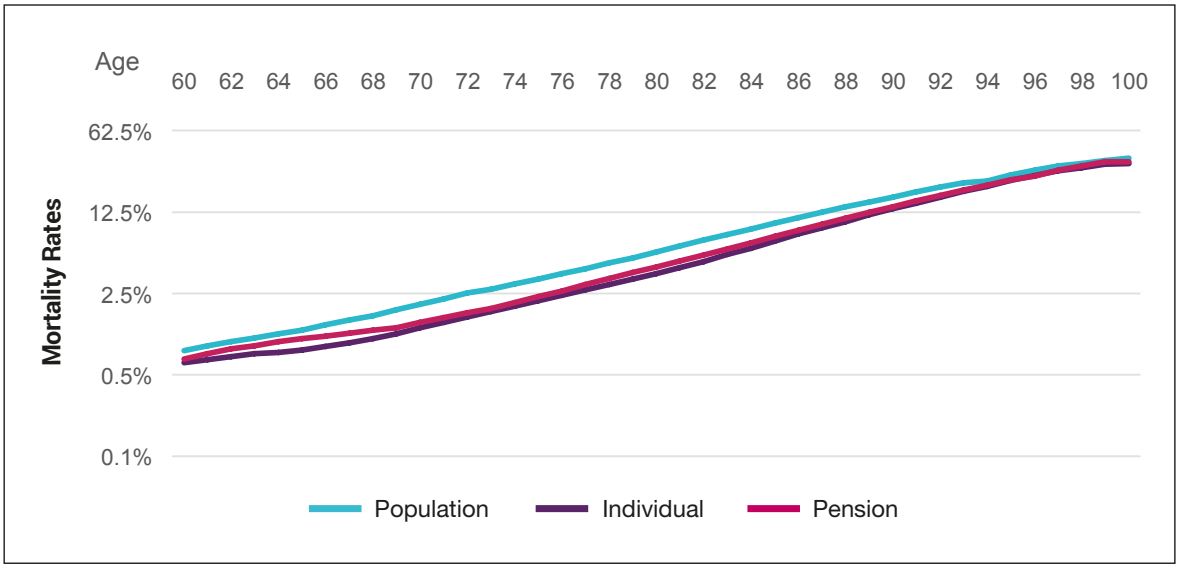
At this stage, there are no graduated results.

The Working Paper does not provide a comparison to population mortality, but we have provided that comparison by using the National Life Tables for 2011-13 and 2012-14 as published by the UK Office of National Statistics.

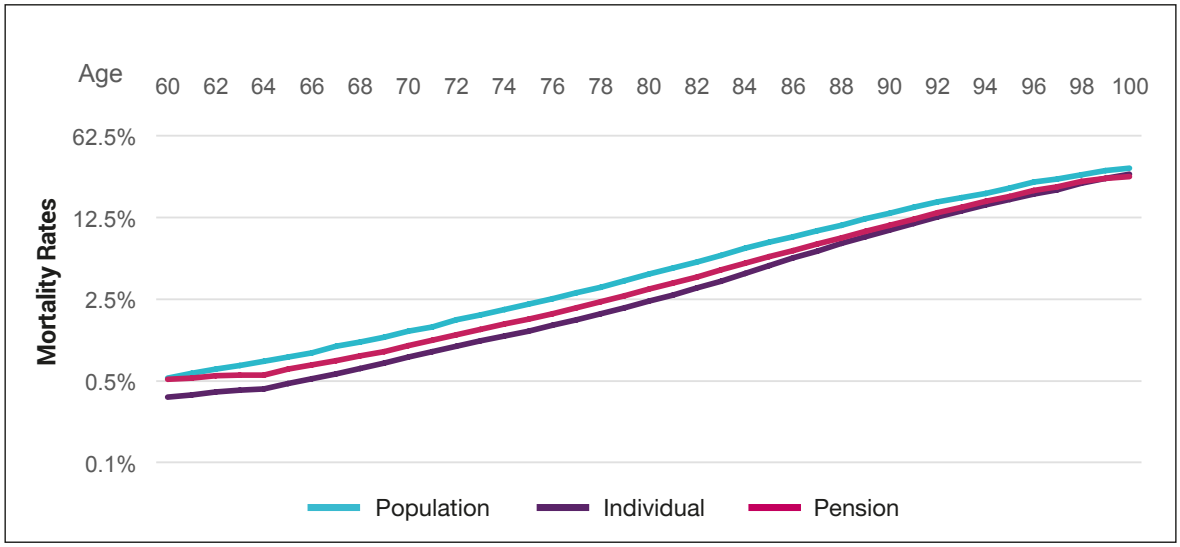
3.4.1 Mortality rates

Graph 15 and Graph 16 show the ungraduated mortality rates (qx) determined from the data set for Individual and Pension annuities in comparison to the mortality rates from the National Life Tables 2012 14. Note the logarithmic scales.

Graph 15. Mortality rates, male, ages 60 through 100 – (q_x) (UK)



Graph 16. Mortality rates, female, ages 60 through 100 – (q_x) (UK)

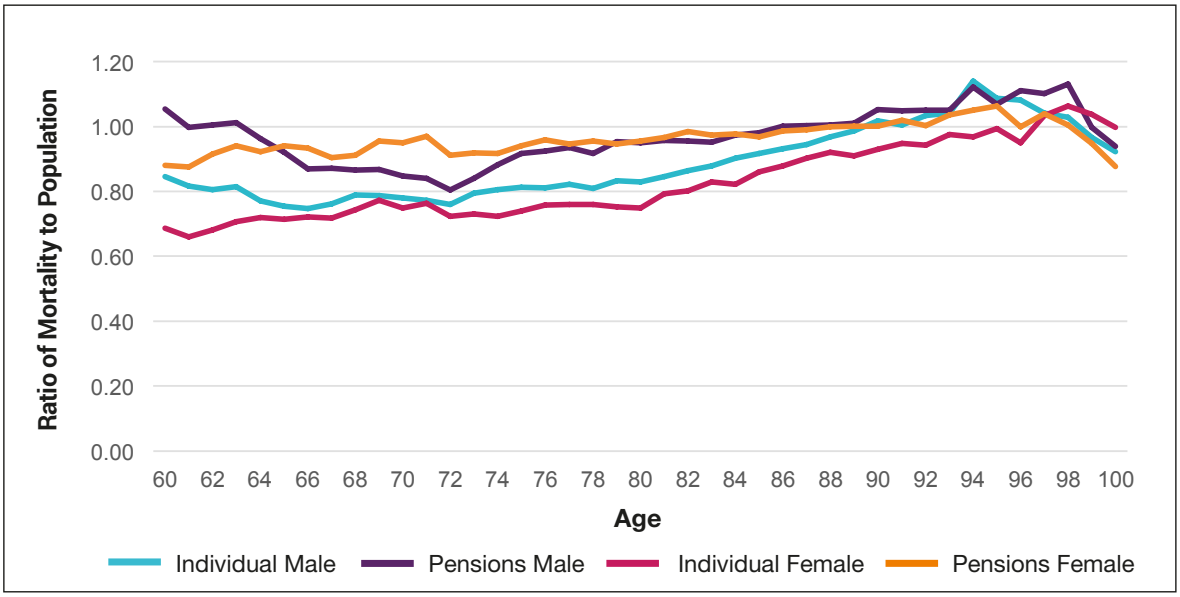


3.4.2 Mortality relative to population

A comparison to population mortality further demonstrates the differences in experience between Individual and Pension annuitants and also provides an assessment as to whether there has been a systematic change in relativities between the series.

Graph 17 shows the ratio of Individual annuitant and Pensioner annuitant mortality to UK population mortality for males and females.

Graph 17. Mortality relative to population (qx) (UK)



The graph shows:

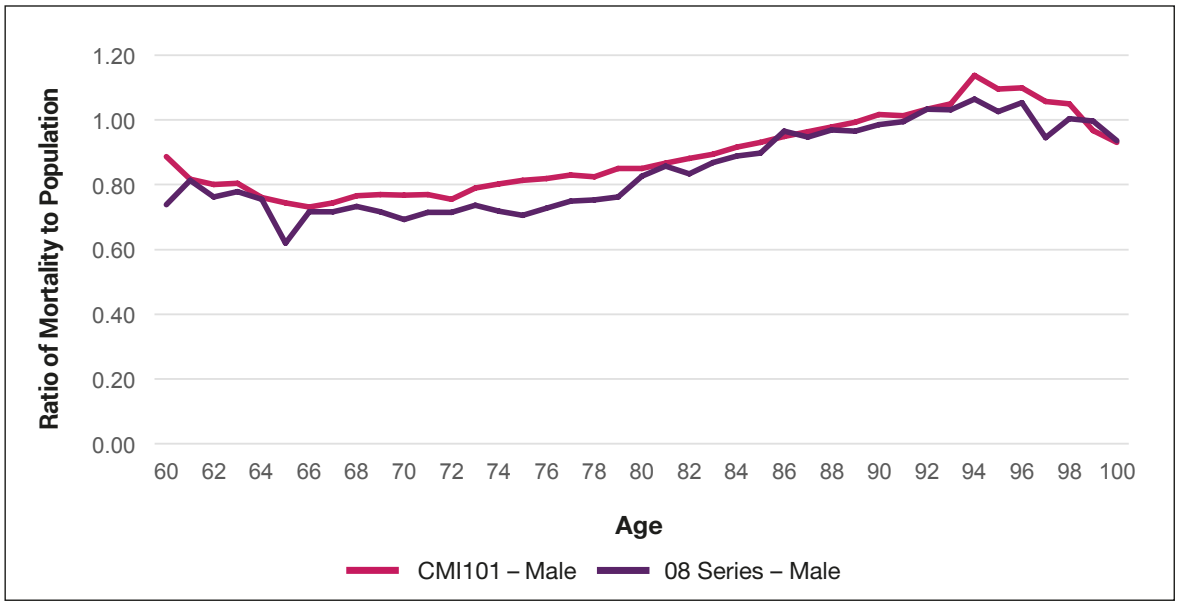
- The experience for Individual annuities is lower than for Pension annuities. This probably reflects the greater personal choice for the individual purchasers who would have had greater opportunity to consider Enhanced Annuities. Whilst not shown here, the experience for Individual annuities that were purchased via External channels (i.e. advised) is lower than those where the annuitant (even though controlling the purchase) simply stayed with their pension provider.

- The Individual experience for females relative to population is better than for males. The reason for this is not clear but may relate to the socio-economic selection of those who are members of pension plans and therefore have the opportunity to purchase annuities. In other words, it might be due to biases in the employment patterns of women and men. Women might also be more selective in their purchases.
- The Pension experience for males and females relative to population is broadly similar.
- The relativities to population mortality are broadly similar to the relativities for the 08 Series. The 08 Series did not separate Individual and Pension annuities. The similarities of the aggregate experience are demonstrated in Section 3.4.3.

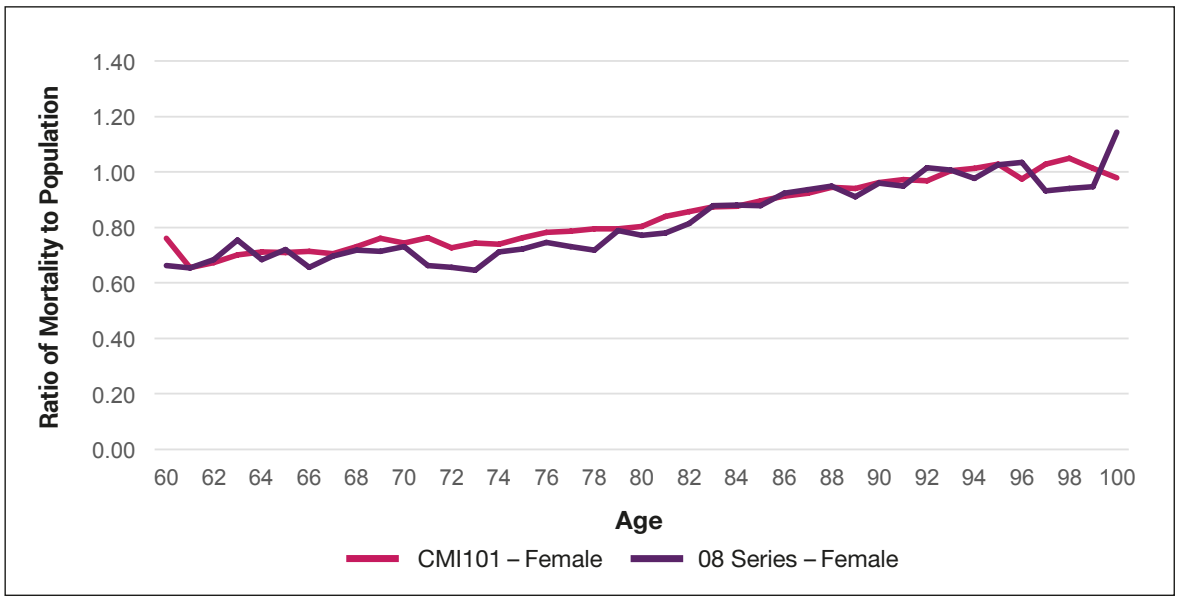
3.4.3 Comparison to previous series

The 08 Series did not separate Individual and Pension annuities. The following comparisons, therefore, combine the Individual and Pension annuity data from the CMI101 study. Graph 18 shows the comparison for males and Graph 19 shows the comparison for females.

Graph 18. Comparison of male mortality relative to population for CMI101 and Series 08 (UK)



Graph 19. Comparison of female mortality relative to population for CMI101 and Series 08 (UK)

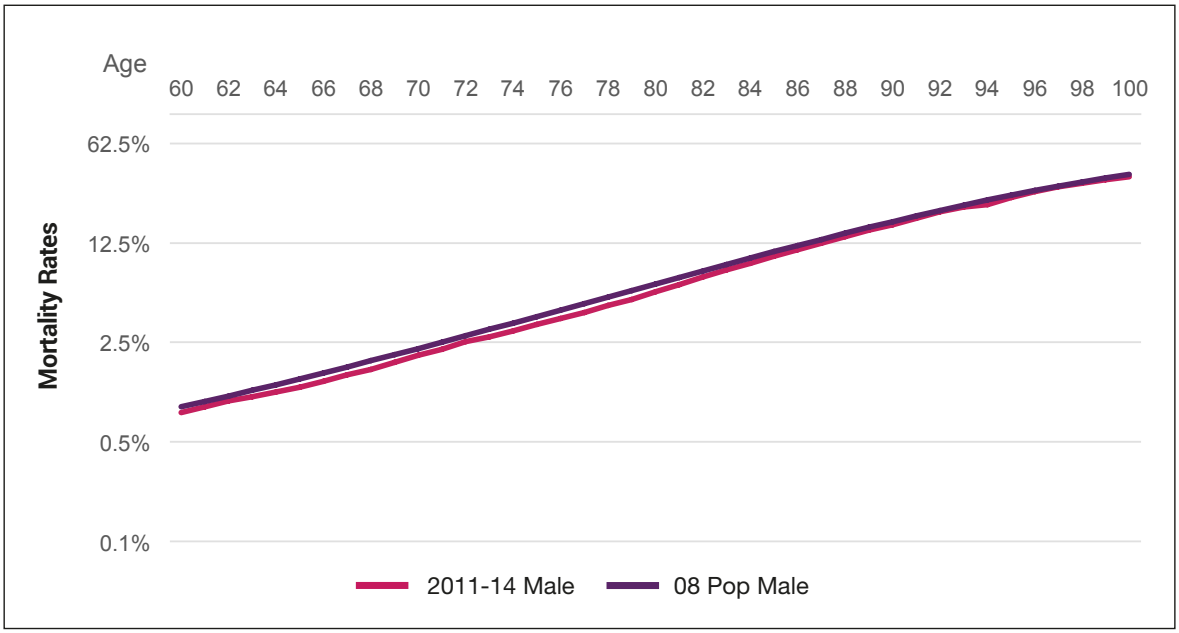


The comparison curves for the CMI101 Series and the 08 Series are very similar, especially for females. The Male CMI101 curve is slightly higher than the corresponding 08 Series curve, but the differences are small and within the graduation errors.

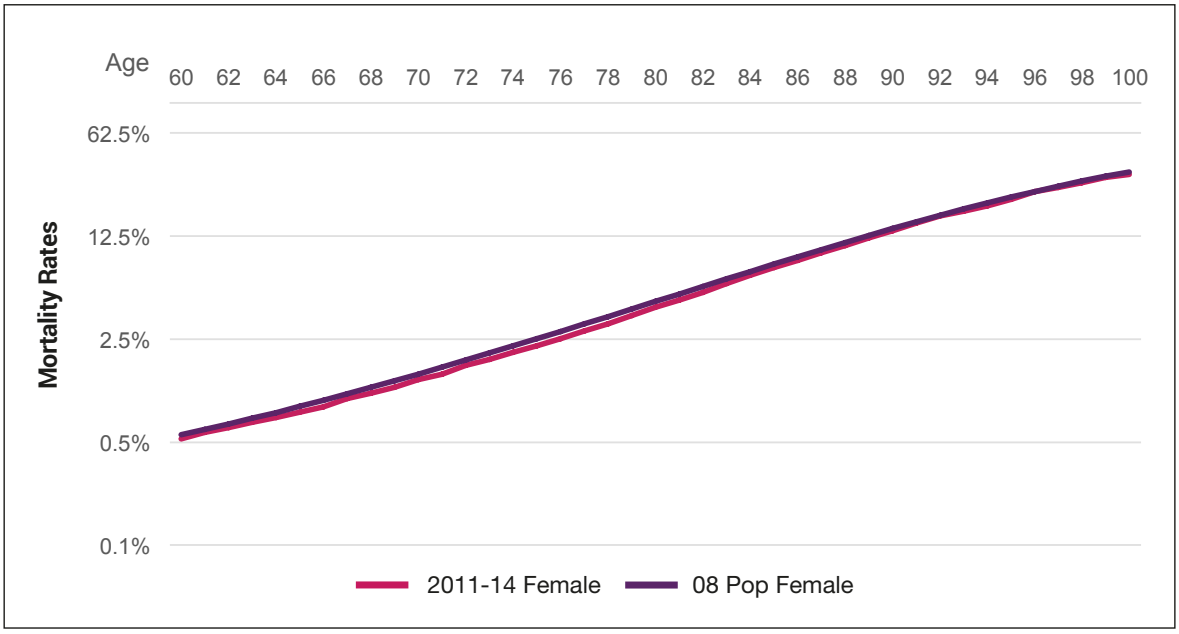
3.4.4 Changes in underlying population mortality

Because we are considering annuitant mortality in comparison to population mortality, it is also necessary to consider how UK population mortality changed over the period between the two series. Graph 20 shows the comparison for Male lives and Graph 21 the comparison for Female lives.

Graph 20. Comparison of population mortality rates (q_x) – Males (logarithmic scale) (UK)



Graph 21. Comparison of population mortality rates (q_x) – Females (logarithmic scale) (UK)



These graphs show that in the period between the series, there was an improvement of population mortality rates. The average improvement was approximately 8.5% for Males and 6.5% for Females with the biggest improvements in the 70 to 80 age group.

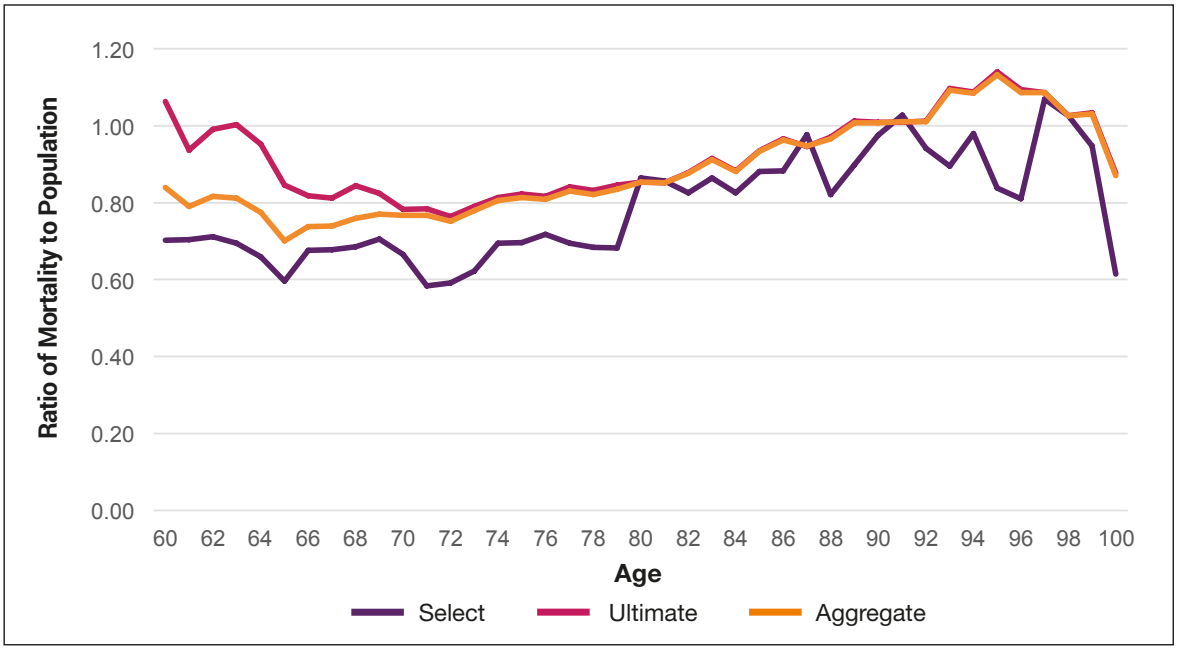
Pension annuitant mortality overall therefore improved in line with the improvements in the population mortality, with the improvement for Males possibly lagging a bit behind the improvement for Females (Graph 18 compared to Graph 19).

3.4.5 The impact of selection

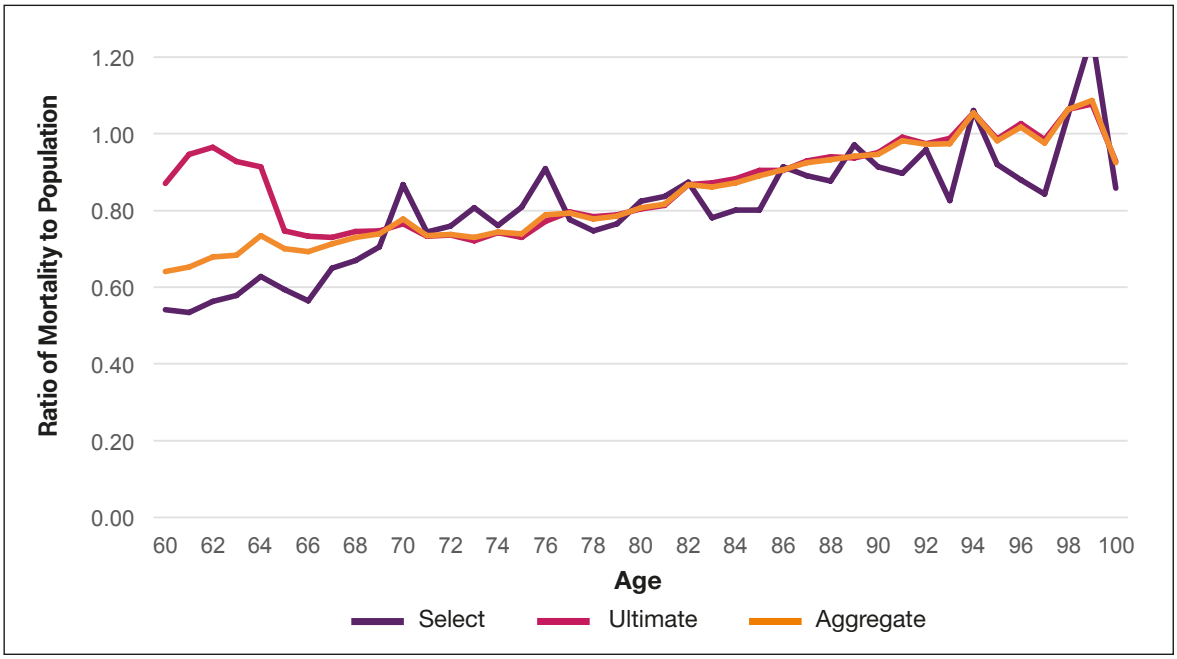
The data allowed us to consider the impact of selection in more detail than was possible for the 08 Series, but we found that the results were similar to those for the 08 Series.

Graph 22 shows the impact of a 5 year select period for Males and Graph 23 shows the impact for Females. A comparison to Graph 11 and Graph 12 respectively indicates that the impact in the two series is equivalent. The effect is noticeable up to approximately age 70 which is the period during which a significant proportion of the products are purchased.

Graph 22. Males ratio of select and ultimate mortality to population – 5 year select period (UK)



Graph 23. Females ratio of select and ultimate mortality to population – 5 year select period (UK)



3.4.6 Socio-economic factors

The CMI has recently released another study in the CMI 101 Series. This is a study of mortality rates for pensioners of self-administered pension schemes. The results were published by the Self-Administered Pension Schemes Mortality Committee in Working Paper 107 dated June 2018.

This study does not have a direct relationship to the analysis we have presented above, but it does contain some interesting work which can aid understanding of the relativities in mortality for pensioners from different socio-economic groups. The working party did not seek to determine socio-economic groupings amongst the data. They instead sought to analyse the differences in mortality by the amount of the pension being paid. They subdivided the male data into twenty groups and the female data into ten groups based on the amount of pension. They then aggregated these groups into four bands so that each band had a sufficiently large data set and the experience of each was significantly different from other bands. The results show clearly that the mortality for those receiving smaller pensions is higher than for those receiving bigger pensions.

The pension amount will be correlated to socio-economic circumstances, because wealthier individuals accrue higher pensions, but the extent of the correlation cannot be determined. The analysis should therefore be regarded as indicative only. The bands selected are shown in Table 1:

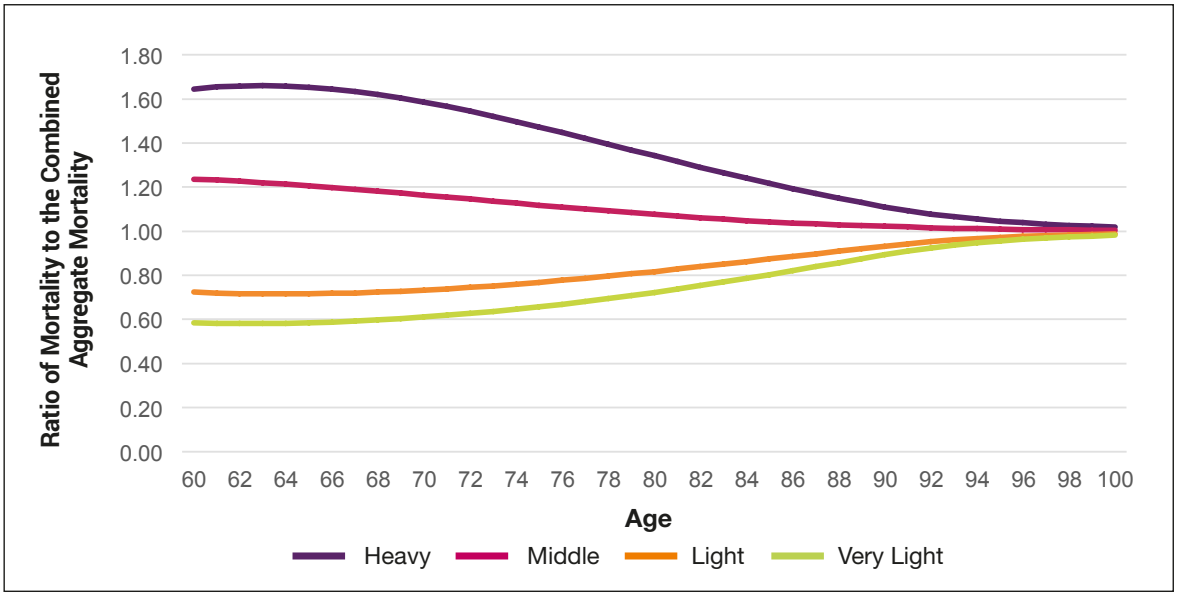
Table 1. Separation of sample by size of pension

Mortality band	Male Pension Range	% of Sample	Female Pension Range	% of Sample
Heavy	£300 – £5,000	40	0 – £1,000	19
Middle	£5,000 – £20,000	45	£1,000 – £8,000	58
Light	> £20,000	15	> £8,000	23
Very Light	> £40,000	3	> £16,000	6

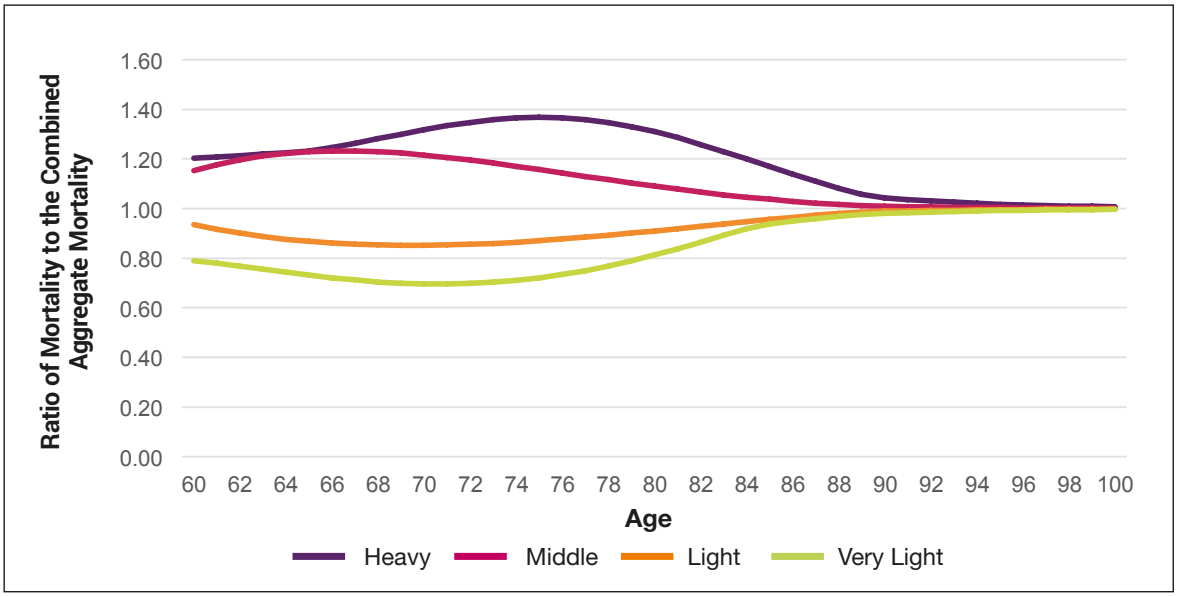
It should be noted that the Very Light band is contained within the Light band.

Graph 24 shows the ratios of the mortality rates for each band compared to the aggregate rates (i.e. all bands combined) for Males. Graph 25 shows the same ratios for Females. At age 60, the mortality rate for Males in the Heavy band is 65% greater than the aggregate rate while the mortality rate for Males in the Very Light band is 52% lower.

Graph 24. Ratio of mortality in each band to the combined aggregate mortality (q_x) – Males (UK)



Graph 25. Ratio of mortality in each band to the combined aggregate mortality (q_x) – Females (UK)



For both Males and Females, the differences between the bands reduce with age, but this was driven by the graduation methodology. The data is much less reliable at older ages and it was assumed that the selection effect would reduce over time.

The results for the Female Heavy band are anomalous when compared to the other Female bands and the Male bands for ages between 60 and 75. No explanation for this is provided, but there may be some systemic factor influencing the results. For example, there may be a higher incidence of pensioners in this band for whom only a portion of their pension is being taken into account. Such pensioners would have a small pension recorded but would have different backgrounds from those who have only accrued a small pension. Biases in the employment of women and their access to pension benefits might also mean that their pension is a lower proportion of the household income than male pensions are – i.e. they may be of a higher socio-economic standing than they appear from their pension amount.

3.5 Summary

The analysis of the UK mortality studies shows:

- There is a significant selective effect from the voluntary purchase of annuities when compared to compulsory purchase – as shown in Graph 9 and Graph 10.
- This effect is similar to the effect experienced for non-smoking insured lives – as shown in Graph 13 and Graph 14.
- There is also a durational selective effect for compulsory purchase annuities which extends up to approximately age 70. This effect could not be assessed for voluntary purchase annuities because of data constraints, but it is likely that an equivalent effect would be found for voluntary purchase annuities.
- The comparison of pensioner (compulsory purchase) mortality to population mortality remained fairly constant between the two series examined. A similar comparison was not possible for voluntary purchase annuities, but it seems likely that it too would have maintained its relativities.
- There are distinct differences in mortality between pensioners according to the size of the pension they receive. The extent of these differences is an indicator of likely differences between socio-economic groups – although it was not possible to determine specifics.

Please note that the mortality rates analysed have all been on a 'lives' basis. Mortality rates analysed by amount are lower because those receiving the higher amounts (and therefore more heavily weighted) have lower mortality.

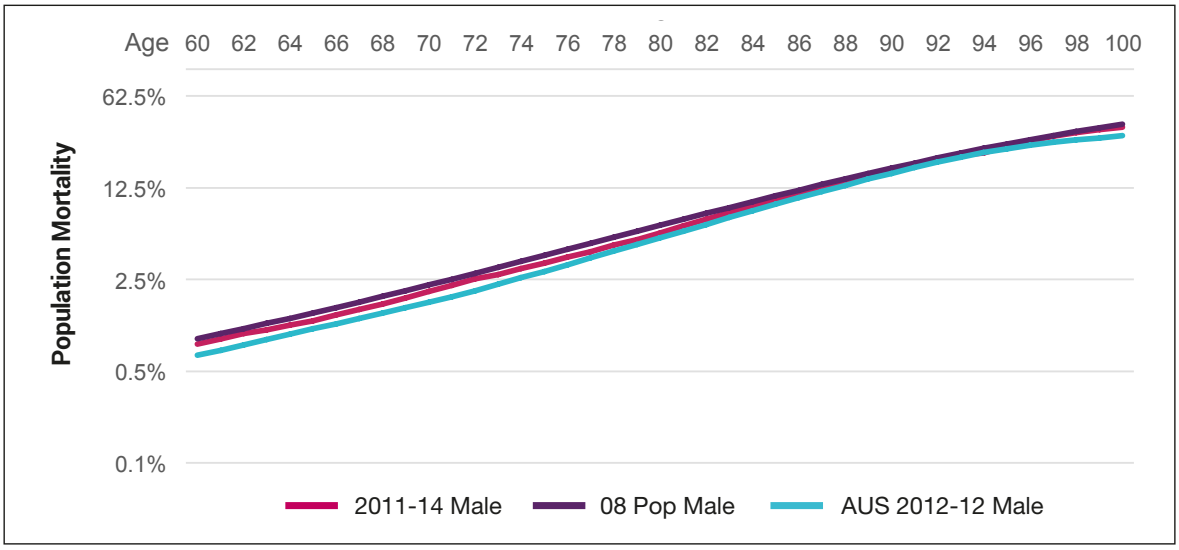
4. Australian mortality outcomes

The premise to this study was that the relativities between annuitant and pensioner mortality and population mortality in the UK would provide a basis for assessing annuitant mortality in Australia relative to Australian population mortality. The robustness of this premise cannot be tested directly because of the absence of Australian annuitant mortality data – the reason for adopting this approach. We are, however, able to examine the differences in population and pensioner mortality as an indicator.

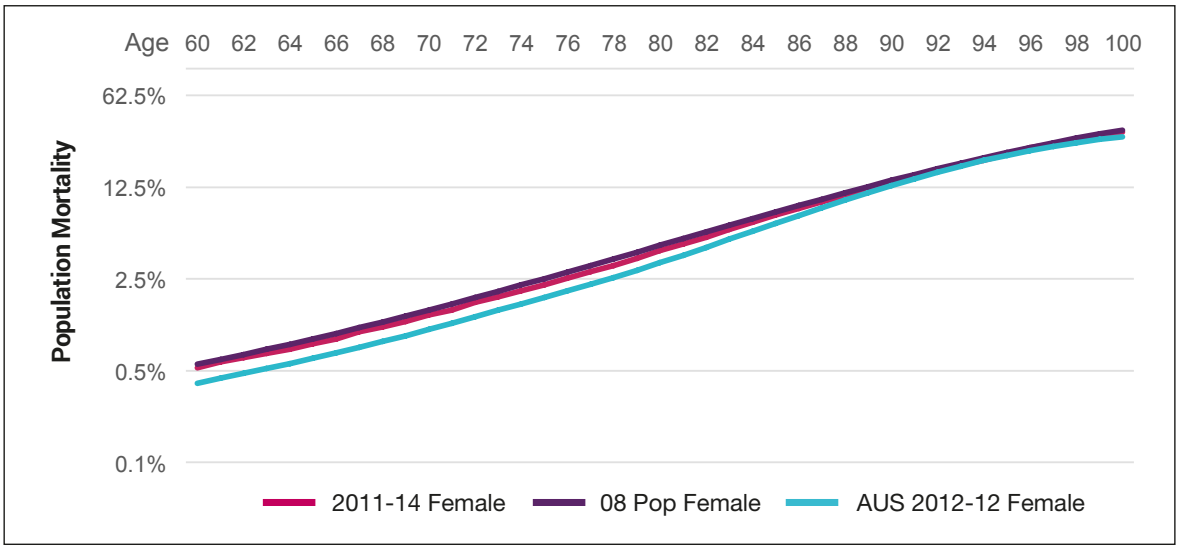
4.1 Australian population mortality rates

For the purposes of this study we have used the Australian Life Tables 2010-12 as prepared by the Australian Government Actuary. The period for this table falls between the periods for the two UK studies. A comparison of the three tables is shown in Graph 26 for Males and Graph 27 for Females.

Graph 26. Comparison of population mortality UK and Australia – Males (q_x)



Graph 27. Comparison of population mortality UK and Australia – Females (q_x)



These graphs show that Australian population mortality is lighter than UK population mortality especially at the younger ages. The Australian rates are approximately 25% lower for Males and 28% lower for Females up to approximately age 80. The differences then reduce until increasing again from approximately age 95. Overall, Australian mortality rates are 18% lower for Males and 20% lower for Females.

4.2 Comparison of pensioner mortality experience

Materially lower population mortality rates raise the question of whether the scaling factors derived from the UK experience will be applicable. A comparison of the mortality rates derived from the Mercer Pension experience can assist with this assessment.

The Mercer data applies to the mortality experience of pensioners in public sector pension schemes. The data covers the years 1990-91 to 2014-15 with exposure and deaths for each year in the range. For this analysis, we have considered data for the period 2007-08 to 2014-15.

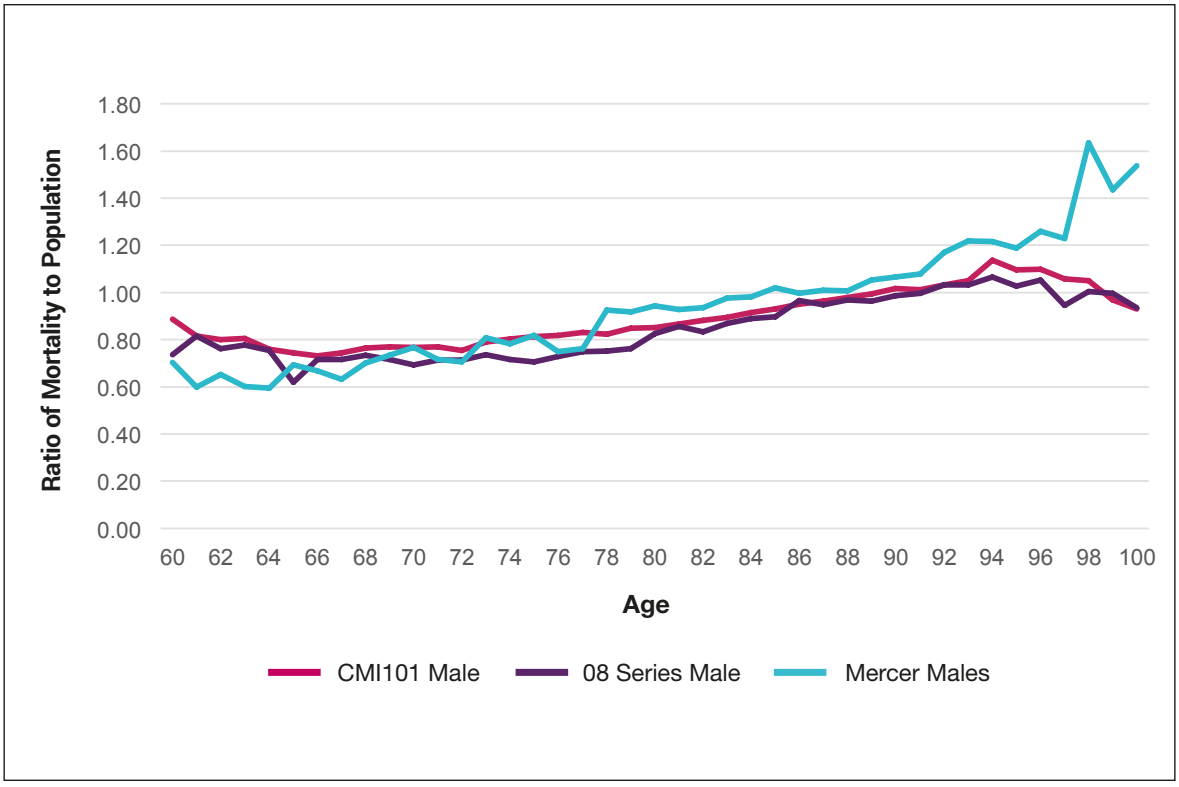
The Mercer data is drawn from funds that include:

- Funds that provide an automatic, compulsory pension benefit.
- Lump Sum funds that provide a very generous conversion to pension – thereby ensuring that most members take a pension.
- Pension funds with the option to commute to a lump sum, but with commutation factors that do not favour commutation – thereby also ensuring that most members take a pension.

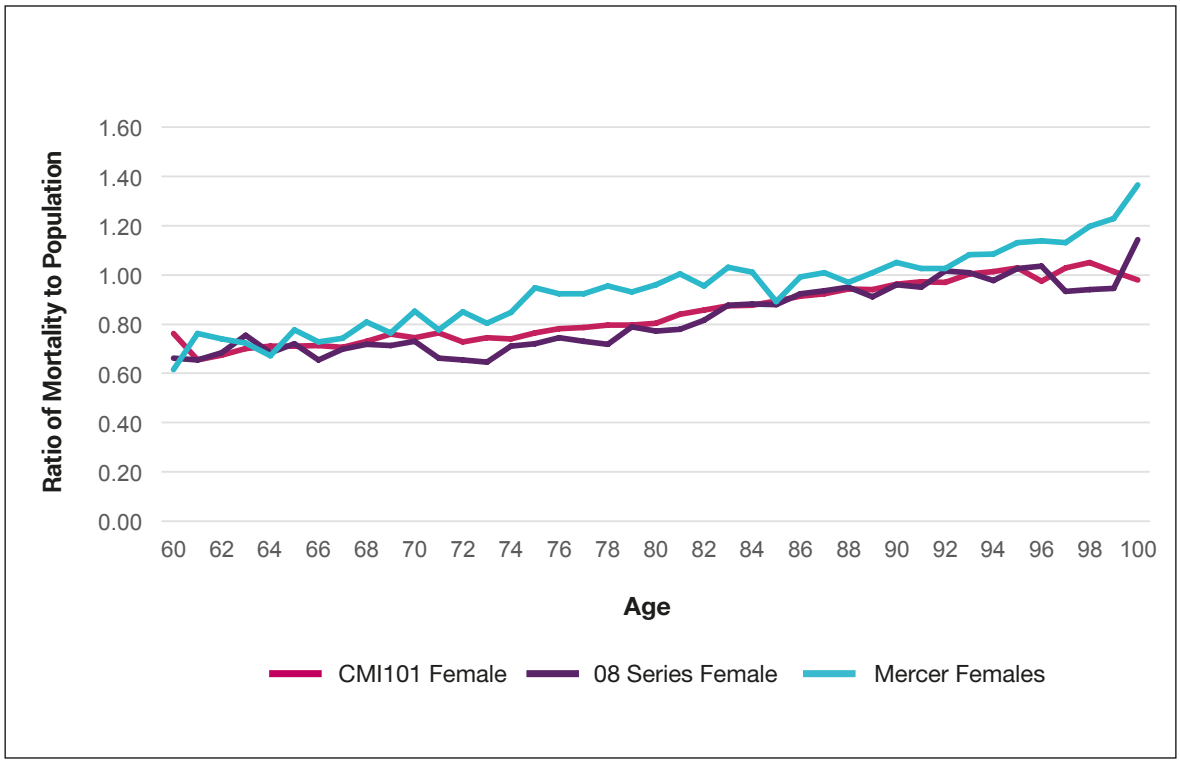
Several of the funds within the Mercer data provide reversionary pension benefits on the death of the primary beneficiary and thereby favour the use of pensions rather than lump sums. This means that the selection profile within the Mercer data is more similar to that for UK pensioners than to voluntary purchase annuities – which would be applicable to non-public sector retirees in Australia.

Graph 28 shows the ratios to population mortality for Males for the CMI101 study (who are pensioners), the 08 Series pensioner experience and the Mercer results. Graph 29 shows the equivalent ratios for Females.

Graph 28. Male mortality ratio to population (Australia compared to UK)



Graph 29. Female mortality ratio to population (Australia compared to UK)



These graphs show that ratios to population mortality are generally higher for Australia. For Males the differences are not great up to approximately age 90 after which the Australian experience moves above population rates. For Females the ratios for Australia are above the UK ratios throughout and the experience also moves above population rates from approximately age 90. Small exposures and the low number of deaths in the Mercer data above age 90 mean that the results are much less reliable in this range.

4.3 Indicative annuitant mortality rates

The analysis suggests that the approach of extrapolating the UK experience as a proportion of population mortality to Australian population mortality as a means of estimating annuitant mortality rates has some merit. The materially lower Australian population mortality rates do, however, suggest that the simple application of the UK ratios might yield mortality rate estimates that are a little too low. Unfortunately, as already indicated, we have no data with which to test our hypothesis, so we have prepared estimated mortality rates on two bases. Basis 2 is a mechanistic adjustment of the results of Basis 1 as compensation for the lower population mortality in Australia.

Basis 1: Apply the ratios obtained from the UK study.

Basis 2: Adjust the UK ratio mechanistically as compensation for the lower Australian population mortality by reducing the difference from population by half the difference of ALT 2010-12 from the UK population mortality rate derived from the average of ONS 2011-13 and ONS 2012-14.

Example: Male aged 60

Ratio ALT/UK = 0.820 i.e. Difference = -0.180 and half this difference is -0.090

UK Ratio Annuity/Population = 0.35 i.e. Difference = -0.65

Adjusted Difference = (1 - 0.090)* -0.65 = -0.591

Adjusted Ratio Annuity/Population = 1 - 0.591 = 0.409

This adjustment is arbitrary and is simply a means of providing a range of mortality outcomes for consideration.

Table 2. Indicative annuitant mortality rates (q_x) – Males (Australia)

Age	ALT 2010-12 (q_x‰)	Ratio ALT/UK	Ratio Annuitant/ Population	Adjusted Ratio	Annuity q_x‰ Basis 1	Annuity q_x‰ Basis 2
60	6.60	0.820	0.350	0.409	2.31	2.70
61	7.22	0.830	0.360	0.414	2.60	2.99
62	7.92	0.820	0.390	0.445	3.09	3.52
63	8.70	0.850	0.400	0.445	3.48	3.87
64	9.57	0.840	0.420	0.466	4.02	4.46
65	10.51	0.860	0.430	0.470	4.52	4.94
66	11.52	0.850	0.470	0.510	5.41	5.87
67	12.61	0.850	0.490	0.528	6.18	6.66
68	13.82	0.850	0.510	0.547	7.05	7.56
69	15.19	0.830	0.530	0.570	8.05	8.66
70	16.75	0.820	0.550	0.591	9.21	9.89
71	18.54	0.830	0.560	0.597	10.38	11.08
72	20.61	0.810	0.570	0.611	11.75	12.59
73	23.00	0.840	0.600	0.632	13.80	14.53
74	25.74	0.850	0.610	0.639	15.70	16.45
75	28.87	0.870	0.640	0.663	18.48	19.15
76	32.43	0.890	0.650	0.669	21.08	21.70
77	36.46	0.910	0.680	0.694	24.79	25.31
78	40.99	0.900	0.690	0.706	28.28	28.92
79	46.10	0.930	0.710	0.720	32.73	33.20
80	51.89	0.920	0.720	0.731	37.36	37.94
81	58.42	0.920	0.740	0.750	43.23	43.84
82	65.77	0.900	0.770	0.782	50.64	51.40
83	74.01	0.920	0.790	0.798	58.47	59.09
84	83.21	0.920	0.810	0.818	67.40	68.03
85	93.42	0.930	0.810	0.817	75.67	76.29
86	104.70	0.930	0.850	0.855	88.99	89.54
87	117.09	0.950	0.860	0.864	100.69	101.10
88	130.62	0.940	0.870	0.874	113.64	114.15
89	145.32	0.940	0.890	0.893	129.34	129.82
90	161.21	0.960	0.900	0.902	145.09	145.41
91	178.20	0.960	0.930	0.931	165.72	165.97
92	195.83	0.950	0.940	0.942	184.08	184.37
93	213.61	0.950	0.940	0.942	200.79	201.11
94	231.06	1.000	0.930	0.930	214.88	214.88
95	247.77	0.950	0.950	0.951	235.38	235.69
96	263.34	0.930	0.940	0.942	247.54	248.09
97	277.43	0.900	0.940	0.943	260.79	261.62
98	289.72	0.880	0.950	0.953	275.23	276.10
99	299.89	0.860	0.960	0.963	287.89	288.73
100	312.55	0.860	0.960	0.963	300.05	300.92
101	324.61	0.850	0.980	0.982	318.12	318.61
102	336.25	0.840	0.980	0.982	329.53	330.06
103	347.85	0.820	0.970	0.973	337.42	338.36
104	360.42	0.810	0.980	0.982	353.21	353.90
105	372.48	0.810	0.980	0.982	365.03	365.73
106	384.12	0.810	0.980	0.982	376.44	377.17
107	395.36	0.810	0.980	0.982	387.46	388.21
108	406.20	0.800	0.990	0.991	402.14	402.54
109	416.64	0.800	0.980	0.982	408.31	409.14

Table 3. Indicative annuitant mortality rates (q_x) – Females (Australia)

Age	ALT 2010-12 (q_x‰)	Ratio ALT/UK	Ratio Annuitant/ Population	Adjusted Ratio	Annuity q_x‰ Basis 1	Annuity q_x‰ Basis 2
60	4.01	0.750	0.350	0.431	1.40	1.73
61	4.38	0.760	0.390	0.463	1.71	2.03
62	4.77	0.770	0.400	0.469	1.91	2.24
63	5.20	0.760	0.430	0.498	2.23	2.59
64	5.67	0.770	0.450	0.513	2.55	2.91
65	6.20	0.770	0.470	0.531	2.92	3.29
66	6.81	0.780	0.510	0.564	3.48	3.84
67	7.52	0.760	0.530	0.586	3.98	4.41
68	8.32	0.770	0.550	0.602	4.58	5.01
69	9.25	0.780	0.580	0.626	5.36	5.79
70	10.31	0.780	0.580	0.626	5.98	6.45
71	11.51	0.800	0.610	0.649	7.02	7.47
72	12.88	0.780	0.630	0.671	8.11	8.64
73	14.42	0.790	0.660	0.696	9.52	10.03
74	16.15	0.790	0.680	0.714	10.98	11.52
75	18.08	0.810	0.680	0.710	12.29	12.84
76	20.24	0.800	0.710	0.739	14.37	14.96
77	22.73	0.800	0.720	0.748	16.36	17.00
78	25.64	0.810	0.730	0.756	18.72	19.37
79	29.08	0.800	0.760	0.784	22.10	22.80
80	33.16	0.820	0.760	0.782	25.20	25.92
81	37.97	0.830	0.770	0.790	29.24	29.98
82	43.61	0.840	0.780	0.798	34.01	34.78
83	50.17	0.840	0.790	0.807	39.63	40.47
84	57.73	0.860	0.800	0.814	46.18	46.99
85	66.38	0.870	0.810	0.822	53.76	54.58
86	76.18	0.880	0.830	0.840	63.23	64.01
87	87.20	0.900	0.840	0.848	73.25	73.95
88	99.50	0.930	0.850	0.855	84.58	85.10
89	113.13	0.920	0.860	0.866	97.29	97.92
90	128.10	0.940	0.880	0.884	112.73	113.19
91	144.44	0.950	0.880	0.883	127.11	127.54
92	162.09	0.960	0.900	0.902	145.88	146.21
93	180.65	0.980	0.890	0.891	160.78	160.98
94	199.68	0.990	0.920	0.920	183.70	183.78
95	218.77	0.980	0.910	0.911	199.08	199.27
96	237.55	0.940	0.920	0.922	218.54	219.11
97	255.68	0.960	0.930	0.931	237.78	238.14
98	272.85	0.940	0.930	0.932	253.75	254.33
99	288.80	0.920	0.940	0.942	271.47	272.16
100	303.26	0.920	0.940	0.942	285.07	285.80
101	318.80	0.900	0.960	0.962	306.05	306.68
102	333.82	0.880	0.960	0.962	320.47	321.27
103	348.41	0.870	0.960	0.963	334.47	335.38
104	362.55	0.860	0.950	0.954	344.42	345.69
105	376.24	0.850	0.960	0.963	361.19	362.32
106	389.47	0.840	0.960	0.963	373.89	375.14
107	402.25	0.830	0.960	0.963	386.16	387.53
108	414.57	0.810	0.960	0.964	397.98	399.56
109	426.43	0.800	0.970	0.973	413.63	414.91

4.4 Improvement factors

A crucial aspect of pricing retirement income products will be the allowance made for future improvements in mortality rates. The analysis we have carried out indicates that the ratio of the mortality of retirement annuitants to population mortality remained much the same between the two UK studies – within statistical variability, although it is noteworthy that this was over only a short period of time.

Our approach has been to construct indicative annuitant mortality tables as a proportion of population mortality. This approach can be extended to improvements as well which have typically been observed over longer periods of time in Australia. The Australian Government Actuary has provided two scales of improvement factors to be applied to the ALT 2010-12 tables. These scales are based on trends over the 25 years and 125 years to 2010/12.

The 125-year scale shows bigger improvements at younger ages than the 25-year scale does reflecting improvements in peri-natal health, sanitation and the treatment of infectious diseases in the early 20th century. The 25-year scale shows bigger improvements in ages over 50 and especially in the retirement ages, reflecting significant improvements in the treatment of heart disease, cancer and stroke and the reduction in smoking. We make no recommendation of choice of scale.

The improvement in annuitant mortality rates can be determined by applying the ratios provided in Table 2 and Table 3 to the improved ALT 2010-12.

4.5 Limitations and disclaimer

As noted already in this paper, the estimates provided above come with significant qualifications and therefore limitations. These mortality rates are indicative only and based on the assumption that the relativities of UK annuitant mortality to UK population mortality can be applied to Australia. The analysis in this report suggests that this is not an unreasonable assumption, but we have no definitive data to indicate that it is correct. This report is provisional for discussion purposes only and does not constitute consulting advice on which to base decisions. No liability to any party will be accepted for the consequence of relying on its contents.



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