COVID-19 Longevity Scenarios

Technical Appendix – UK Scenarios v1.0

March 2021

Introduction

Welcome to our Technical Appendix supporting our 2021 COVID-19 Longevity Scenarios report. The purpose of this document is twofold:

1) To provide additional information on the structure of our four COVID-19 scenarios; and

2) To set out the data and wider assumptions used to calculate the liability impacts and cashflows described in our report

This document is therefore split into two sections.

Our scenarios report sets out four diverse potential future longevity scenarios, in each case considering the projected evolution of life expectancy and the likely impact on liabilities. The scenarios include a range of future outcomes, some which might be considered more central (i.e. what some might view as 'best estimates'), and others which result in a larger shift in longevity improvements compared with pre-COVID expectations. Note that the extreme scenarios are not intended to reflect bounds of potential outcomes.

To construct our scenarios, we have calculated overlays to be applied to existing calibrations of the CMI Mortality Projections Model. These overlays allow us to provide for uplifted mortality rates in the short-term (for example during 2020 and 2021) compared with pre-COVID expectations. They also allow us to modify pre-COVID expectations of mortality improvements in the longer term. For example, we can allow for an expectation of elevated mortality during the first part of the 2020s or an expectation of lower than expected improvements during the latter part of the 2020s and 2030s. We also consider whether these mortality overlays should vary by sex, age and socioeconomic group (or "SEG").

In all cases, we compare the scenario to a benchmark pre-COVID scenario. This is an extended parameterisation of the CMI_2019 Mortality Projections Model, using the A parameter to set differential pre-COVID-19 expectations for different socioeconomic groups, reflecting the differential improvement trends that have been observed in pension plan and population data during the 2010s.

On behalf of all the team we thank you for your interest in this research and we would be delighted to respond to any questions you may have.

We wish everyone a safe and healthy 2021.

			
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Reliances and Limitations

In this Technical Appendix, Club Vita (UK) LLP ("CV") provides supplementary information about the construction of the scenarios described in our research paper "COVID-19 longevity scenarios: a bump in the road or a catalyst for change?". It also provides details of the calculations underlying the various period life expectancies, changes to liabilities, cashflows and duration described in that paper. The scenarios are not intended to represent the complete range of possible outcomes for pension plans in respect of COVID-19 and its aftermath. Further, there are many drivers for changes in longevity that we have not allowed for or fully considered. Allowing for these drivers is likely to lead to a wider range of outcomes than presented in our paper. The scenarios are intended to be used by pension plans considering stress testing their funding strategies, as well as facilitating wider discussions on potential impact of COVID-19.

Contents

Part One: Scenario Construction

In this section we describe the common principles adopted when constructing each of our scenarios. In each of the following four sections we then explain how the individual COVID-19 scenarios were constructed based on these principles[1].

Step One: Setting a pre-COVID expectation for mortality rates

The starting point for each of our scenarios is a set of mortality rates (base tables plus improvements) that we assume would have applied had the pandemic not occurred. These are used both as a comparator for each of our scenarios and as a starting point for each of our scenarios.

In order to capture the diversity of pension plans in the UK, our pre-COVID assumptions vary by socioeconomic group both in terms of baseline mortality and future expectations of improvement in the short-to-medium term. Differential improvements assumptions are allowed for by means of the extended “A” parameter under the CMI’s Mortality Projections Model.

We describe our pre-COVID mortality assumptions in Part Two.

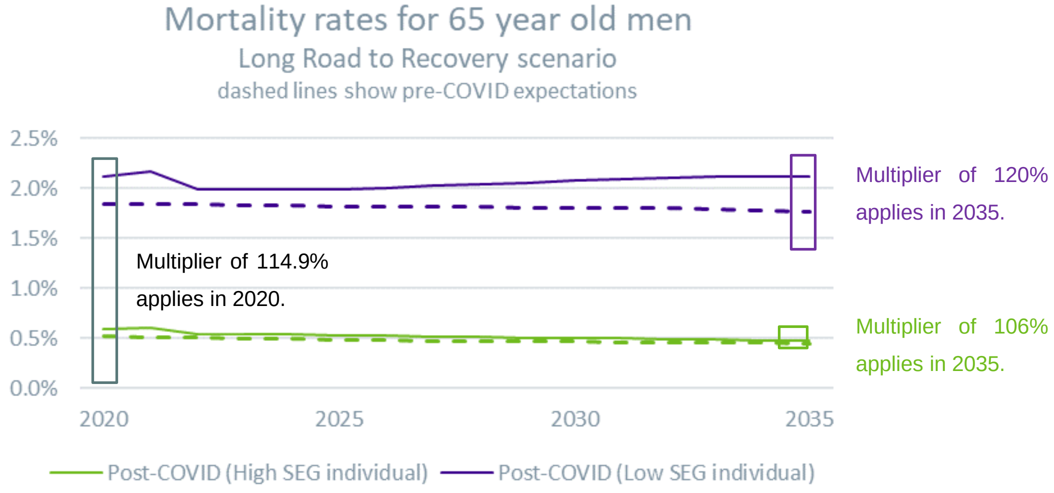
Step Two: Adjusting our pre-COVID expectations

For each of our scenarios, we have applied a multiplier to the pre-COVID mortality expectation. This multiplier varies by calendar year, but also in some cases by sex, by age and by socioeconomic group.

For example, during 2020 we have uplifted the mortality rates in line with the excess mortality observed in the population and have considered whether this uplift should vary by sex, age and socioeconomic group.

Similarly, in some cases we have assumed that mortality rates in (for example) 2035 will be materially higher or lower than we would have expected based on our pre-COVID projections due to the longer-term implications of the pandemic.

To illustrate the application of these mortality uplifts, the chart below gives an example of the “before and after” mortality rates applying to individual men aged 65 in our highest and lowest socioeconomic groups under our Long Road to Recovery scenario.



The overall adjustment applied represents the cumulative impact of four key drivers, which we describe below.

[1] The details of our Pre-COVID reference scenario is outlined in Part Two.

Identifying key drivers

Each of our scenarios represents the cumulative impact of four key drivers. For each driver we have identified outcomes in relation to that driver within each scenario.

Driver One: Immediate increase in deaths due to COVID-19

This driver will dominate each of our scenarios in the short-term. Importantly, this driver captures both deaths directly related to COVID-19, but also excess mortality from other causes arising during periods of high COVID mortality (net of any reduction in mortality due to offsetting factors such as increased respiratory hygiene reducing influenza prevalence).

During 2020 we saw almost unprecedented levels of excess mortality. Each of our scenarios captures that elevated mortality and an expectation that the first part of 2021 will also see elevated mortality rates. Looking beyond the first and second wave, this driver considers factors including the efficacy of vaccines, take-up rates, improvements in treatments for COVID-19 and continued adherence to social distancing measures. It also includes the risk of mutation leading to a faster spreading or more deadly virus as well as reduced effectiveness of vaccine programs.

Driver Two: Disruption to non-COVID-19 medical care

During 2020, healthcare systems have been severely strained, and many individuals have not received or may not receive the treatment they would have prior to the pandemic. For example, during the first lockdown, cancer screening was suspended, and routine diagnostic work deferred.

This driver considers how long these delays could last and what their impact could be on mortality rates.

Driver Three: Changes to health and care systems

The pandemic has highlighted shortcomings in our health and care systems and exposed the high level of health inequality in our society. Could the pandemic act as a catalyst to improve the existing public health environment – for example with an increased focus on preventative measures and improving population health? In addition, the pandemic has driven innovation in the healthcare system and in vaccine technology. Could this innovation help drive change in the longer term?

Driver Four: Global recession

On the other side of the coin, a long-lasting recession caused by the pandemic will limit the amount that governments, employers and individuals are able to spend on healthcare and on encouraging or making lifestyle changes which are associated with positive health outcomes. This driver captures the impact of a long-lasting economic downturn on population health.

Drivers we haven't directly allow for

During the process of building our scenarios, we also considered the impact of several other drivers. Examples include:

- Long-term health consequences of COVID-19 survivors
- Behavioural changes resulting from the pandemic, for example smoking rates and respiratory hygiene.
- Reductions in air pollution due to reduced economic activity.

Given the broad "helicopter view" taken by our scenarios some of these drivers we concluded were at least implicitly captured in our broad approach to assessing the four main drivers (for example, we take into consideration the long-term health consequences of COVID-19 as a potential negative factor when assessing what mortality rates might look like post-pandemic). Others would be important refinements for those looking to form more detailed / precise narratives e.g. the outlook for long-term health of COVID-19 survivors.

The exclusion of these drivers does not always mean that we do not consider these to be important when setting expectations for future longevity trends. Changes in behaviour (for example smoking rates, but also quality of diet and exercise levels) are a key driver of current differential mortality rates across different socioeconomic groups and are also likely to be a key determinant of levels of future improvements. Lifestyle changes in the longer term (both positive and negative) are implicitly captured in our Drivers Three and Four.

Scenario 1: A Bump in the Road

1.1 Description

In this scenario, COVID-19 has a short and isolated effect. After a marked increase in deaths due to the pandemic in 2020 and the first part of 2021, we return to the pre-pandemic trajectory, although with a couple of "lost years" of longevity improvement that will never be recovered.

We assume that mortality is elevated in 2020 and 2021 (to a lesser degree) as a direct consequence of COVID-19. Following the successful rollout of the vaccine we return to the previous trend in longevity improvements from 2022 onwards, albeit with no catch up of lost ground (i.e. somewhat elevated mortality from 2022 onwards compared with pre-pandemic expectations).

We note that this scenario incorporates the minimal possible set of events that we consider plausible in the future, so may provide for a better comparator for assessing the impact of our other scenarios than the pre-2020 assumption.

[2] In our scenarios paper we also compared excess deaths with the underlying trend for all years back to 1960. In order to do this, we used an advanced version of the CMI Mortality Projections Model using historical data going back to 1960 and fitted mortality rates for each year and compared these with the observed mortality rates.

1.2 How we modelled this scenario

1.2.1 Mortality uplift during 2020

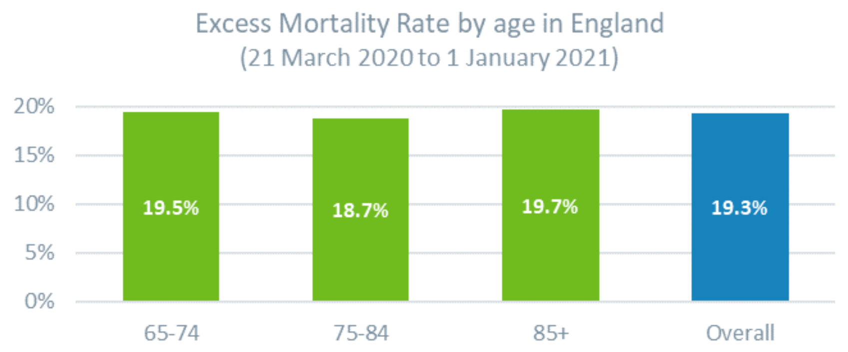
We first considered the overall level of excess mortality during 2020 at the population level in the UK. We then assessed whether this excess mortality rate should vary by sex, by age and by socioeconomic group.

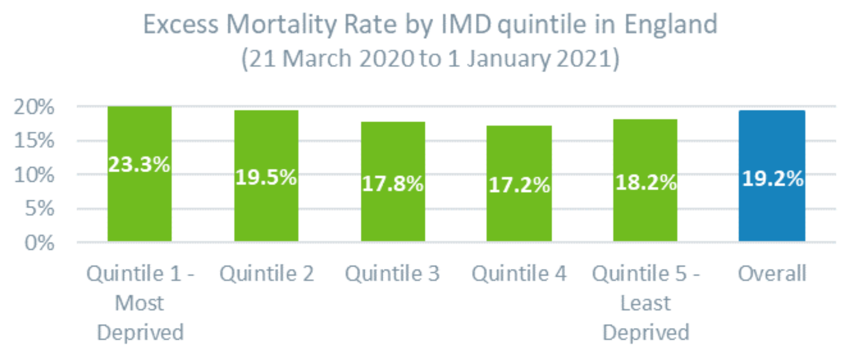
The exact level of excess mortality will depend on the methodology used to estimate the expected number of deaths during 2020. We estimated the number of expected deaths by fitting a linear trend to the number of deaths observed in England & Wales over the period 2015-19. We then validated our estimate based on publicly available sources including Public Health England and the Continuous Mortality Investigation[2]. Finally we then validated that the England & Wales derived figure was appropriate to use for the entire UK population.

The overall level of mortality uplift was assumed to be **13.5%**.

We have allowed for a different level of uplift for men and women reflecting the differentials in excess mortality observed in the population amongst men and women. We allowed for an uplift of **15%** for men and **12%** for women. We have not made any other allowance for differential uplifts, reflecting the fact that the excess mortality rate (as a percentage uplift) has been broadly similar for all age groups over 65[3] and evidence thus far suggests limited gradient across socioeconomic groups in terms of overall excess mortality. **The 2020 Bump in the Road uplift has been replicated across all four of our scenarios.**

[3] See https://fingertips.phe.org.uk/static-reports/mortality-surveillance/excess-mortality-in-england-latest.html





Source: Own calculations based on data from https://fingertips.phe.org.uk/static-reports/mortality-surveillance/excess-mortality-in-england-latest.html

Note: Use of deprivation quintile may fail to capture some of the nuances of differential COVID mortality, for example regional differences, differences between urban and rural areas and variation within the broad postcode areas used to assess deprivation. We are currently exploring the levels of excess mortality see within Club Vita's pension plans to provide further insight into any socioeconomic differentials relevant to Club Vita members.

1.2.2 Mortality uplift during 2021

In our Bump in the Road scenario, we assume that the current vaccine program plus improvements in treatment will have the combined impact of reducing COVID-19 deaths to a very low level by the end of 2021. This will require a successful vaccine roll-out and for the vaccine to be sufficiently effective to remove COVID-19 as a material cause of death. In particular, emerging mutations will be kept under control through vaccination or social distancing measures. Even under this eventuality, we still expect to see a material number of excess deaths during 2021 as the second wave works its way through. We will see overall excess mortality of **10%** during 2021. As in 2020, the excess mortality rate will be higher for men than women.

1.2.3 Mortality rates during 2022 and beyond

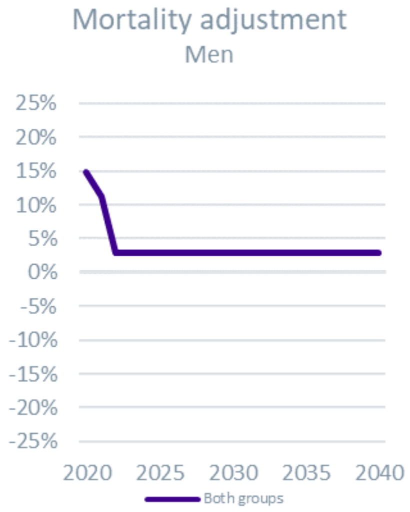
From 2022 onwards, overall mortality rates are assumed to be *higher* than would have been the case had the pandemic not occurred. This is due to a combination of reasons, including impaired health levels of COVID-19 survivors and missed opportunities to improve health outcomes both at an individual and population level due to the distractions caused by the pandemic.

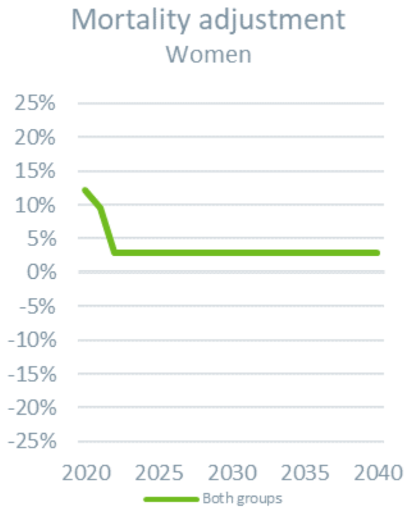
Whilst there may be some residual COVID-19 deaths in 2022 and onwards, this scenario assumes that it will not be a significant cause of death. We also assume that behavioural changes do not persist, so we see limited impact on seasonal mortality rates due to increased awareness of respiratory and hand hygiene.

In order to model this lost ground, we assume that for all years from 2022 onwards, mortality rates are uplifted by **103%,** which is broadly what we would expect from the loss of two of years of mortality improvements based on recent experience. (A lower uplift is applied above age 85 – see below.)

1.3 Mortality uplifts applied (up to age 85)

The charts below show the cumulative mortality adjustment factor applied to pre-COVID expectations in each calendar year from 2020 for our highest and lowest SEG individuals.



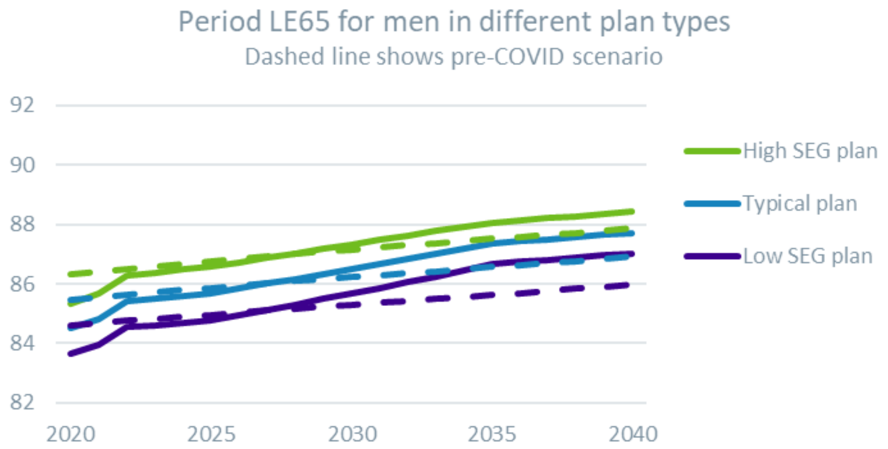


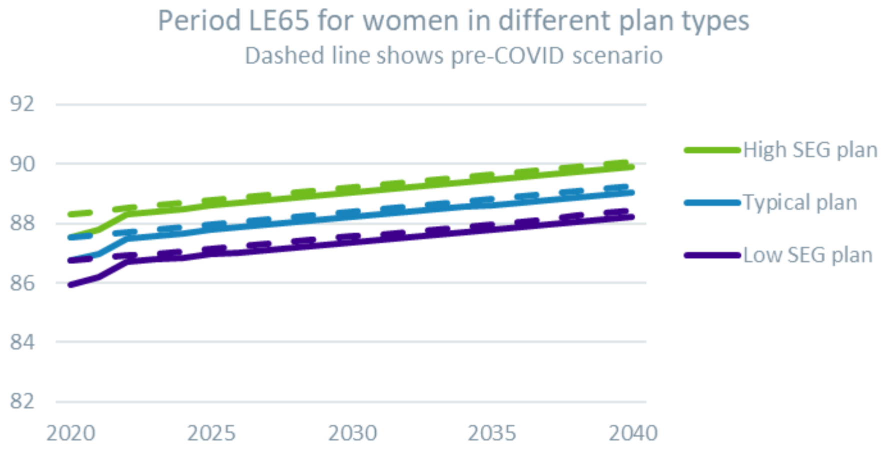
These uplifts apply at all ages up to age 85. For ages 86 and above, the adjustment applied is tapered in the same way that the long-term rate is tapered under the core CMI model.

The taper is assumed to apply to adjustments from 2025 onwards. For short-term shocks associated with the pandemic we have assumed that these shocks apply at all ages, i.e. we have not applied the taper.

1.4 Projecting life expectancy under the scenario

The following charts show the pace of longevity improvement implied by this scenario for three different types of plan with different socioeconomic mixes, focussing on period life expectancy from age 65. We have also shown for comparison how life expectancy would be assumed to evolve under our pre-COVID scenario.





Scenario 2: Innovation in Adversity

2.1 Description

This scenario envisages not only a swift recovery from the pandemic, but also that lessons learnt during the outbreak of COVID-19 act as a catalyst for longer term improvements in health and longevity.

We assume that the roll-out of vaccines proves successful during 2021, and direct COVID-19 deaths will be much lower from 2022 onwards. This release in pressure, in combination with a focussed initiative on catching up on lost ground, means that disruption to non-COVID medical care is limited in impact beyond the first few years of this decade. This period of catch-up will be enabled by the emergence of a "V-shaped" economic recovery, with individual and public finances largely returning to pre-pandemic levels (albeit with large public finance deficits having accumulated during the pandemic).

Once that lost ground has been recovered, the experience of the pandemic spurs on improvements in the way healthcare is delivered with innovations in the delivery of care (for example telemedicine) leading to greater efficiency in delivering positive health outcomes. This scenario also anticipates innovations in vaccine technology having implications beyond COVID-19 to other infectious diseases and some forms of cancer. In addition, intensive efforts will be made to reduce the level of health inequalities that the pandemic has exposed.

In combination, these catalysts for change will lead to a sustained period of longevity improvements during the mid-to-late 2020s and early 2030s. These improvements will be enjoyed across the population, but lower socioeconomic groups will benefit the most due to the concerted drive to reduce health inequalities in the population.

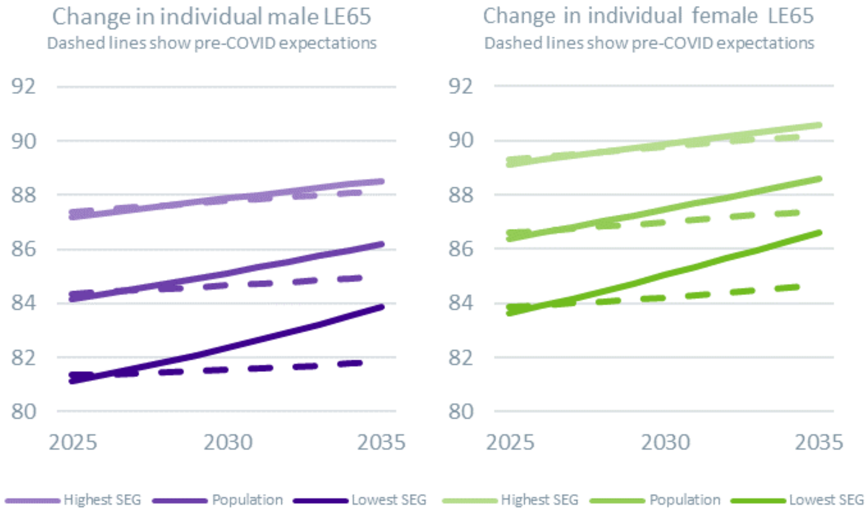
2.2 How we modelled this scenario

2.2.1 2020 through to 2025

The scenario is identical to Bump in the Road.

2.2.2 2025 through to 2035

We allow for a sustained period of strong increases in population life expectancy throughout the period 2025 to 2035 as the catalysts described in the previous section improve population health levels and impact upon mortality rates. In our scenario, we envisage that the period 2025 to 2035 will see an improvement of **just over 2 years** in period life expectancy at 65 ("LE65") for the overall population of the UK (similar to the level of improvement seen during the 2000s). Those in our lowest socioeconomic group are assumed to benefit the most, seeing an improvement of **nearly 3 years** in life expectancy at 65.



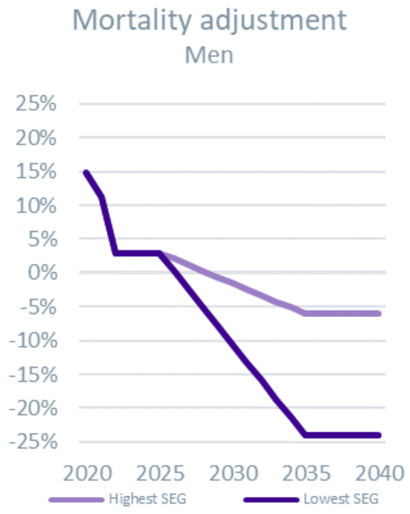
2.2.3 2035 and beyond

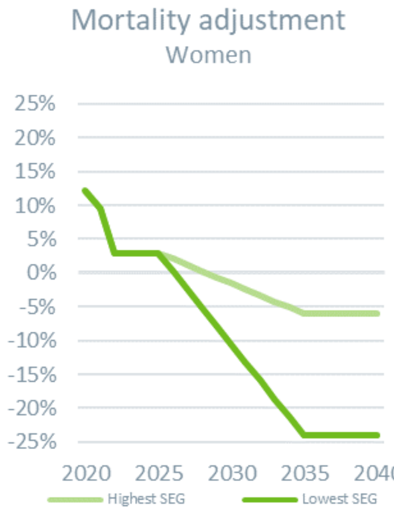
Following this period of rapid rise in life expectancy, we assume a return to the typical rate of mortality improvement seen during recent decades (around 1.5% pa) and used in our reference scenario.

2.3 Mortality Uplifts applied (up to age 85)

The charts below show the cumulative mortality adjustment factor applied to pre-COVID expectations in each calendar year from 2020 for our highest and lowest SEG individuals.

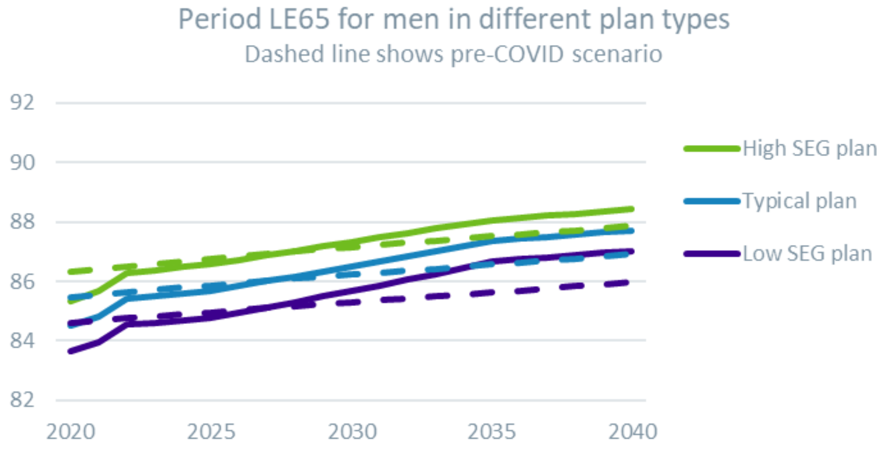
These uplifts apply at all ages up to age 85. For ages 86 and above, the adjustment applied is tapered in the same way that the long-term rate is tapered under the core CMI model.

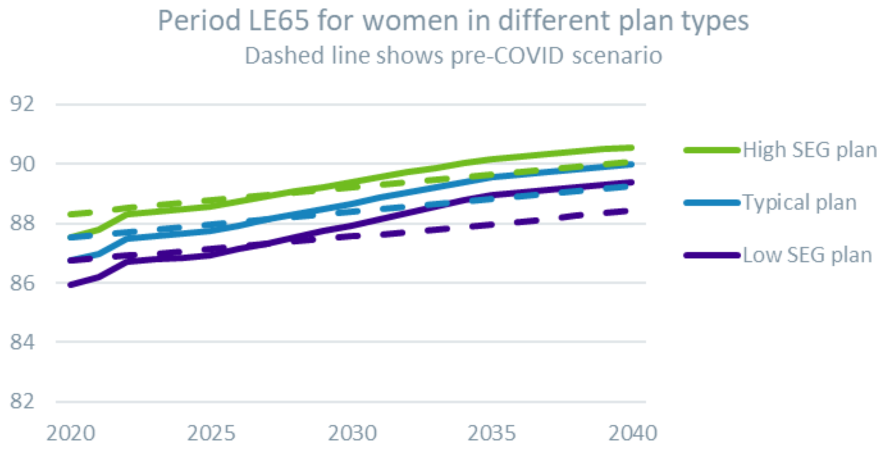




2.4 Projecting life expectancy under the scenario

The following charts show the pace of longevity improvement implied by the scenario for three different types of plan with different socioeconomic mixes, focussing on period life expectancy from age 65. We have also shown for comparison how life expectancy would be assumed to evolve under our pre-COVID scenario.





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Scenario 3: Long Road to Recovery

3.1 Description

In this scenario we assume that challenges both to the efficacy and take up of the vaccine mean that society and the economy are left dealing with lingering effects of the pandemic for a prolonged period.

The 2010s saw low levels of longevity improvement in many countries, including the UK. Many commentators have placed some of the blame for this slowdown on the impact of the 2008 financial crisis. The financial crisis and ensuing spending cuts could also explain the rise in health inequalities over the same period, with the less well-off feeling the effects of strained finances more severely. This scenario anticipates that we will continue to see very low levels of longevity improvements during the 2020s as economic growth continues to falter and governments and employers continue to tighten the purse strings.

While reducing over time due to the emergence of effective vaccines, we will continue to see excess mortality driven by COVID-19 throughout the first half of this decade. This will be driven by new strains of the virus for which the first wave of vaccination programs is less effective and by the relaxation of social distancing measures meaning the virus is able to spread more easily. Associated disruption to non-COVID medical care also continues to impact on mortality rates throughout the decade as individuals present later, and at more advanced stages of disease, than pre-pandemic. However, by the end of the decade we will have largely caught up and reached a new state of equilibrium.

Just like we have seen during the 2010s, individuals in lower socioeconomic groups will suffer the brunt of any cutbacks, either directly through a change in their personal circumstances (for example losing their job or reduced social security payments) or through cutbacks in healthcare provision.

3.2 How we modelled this scenario

3.2.1 Mortality Uplift for 2020

The scenario is identical to Bump in the Road.

3.2.2 Mortality Uplift for 2021

Direct COVID-19 mortality over 2021 will be at a similar level to that seen in 2020. Improvements in treatments and the impact of vaccination programs will be offset by the increased difficulties in controlling the spread of the virus due to short fallings in the effectiveness of vaccines (for example in the older population), the ongoing emergence of new, more virulent strains for which vaccine programs are less effective and lockdown fatigue amongst the population.

In addition, the impact of delays in diagnosis and treatment will start to impact on mortality rates for other causes of death, meaning that the overall number of deaths during 2021 will be slightly higher than in 2020.

Overall, mortality rates at the population level will be around **18%** higher for men and **15%** higher for women than anticipated based on pre-COVID trends.

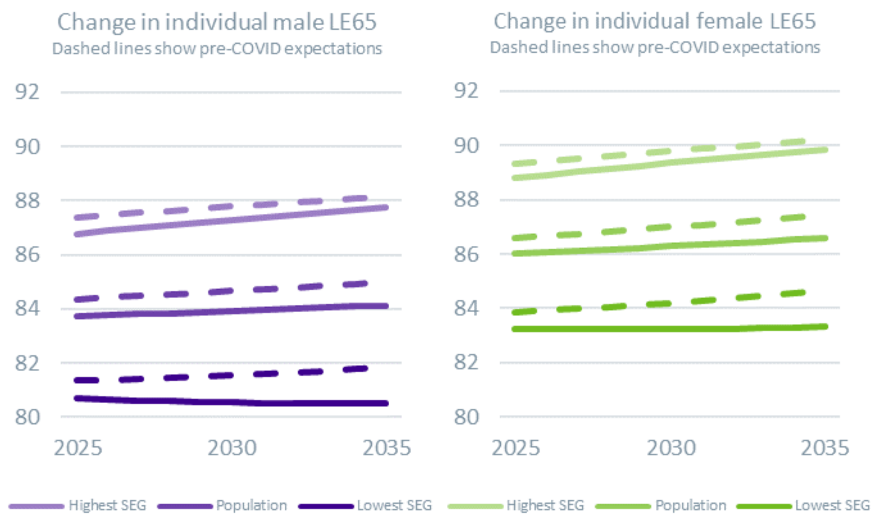
3.2.3 2022 to 2035

From 2022 we will see a much lower level of direct COVID-19 deaths as vaccine programs take full effect. Nevertheless, there will be some residual excess mortality in relation to COVID-19 throughout the period due to vaccines not being sufficiently effective to fully remove the virus from circulation and as new strains emerge both in the UK and overseas.

In addition, the impact of delays of diagnosis and treatment will be a material feature in these years.

Public health initiatives and health care providers focus entirely on controlling COVID-19 infections and on recovering the ground lost during the first part of the 2020s. The “background improvements” from behaviour changes and medical advances implicit in our pre-COVID reference scenario are offset by the fiscal challenges, (modest) ongoing COVID waves and the missed diagnoses/treatments due to COVID disruptions and budgetary constraints.

Consequently, the scenario assumes that improvements in life expectancy in the population throughout the period 2025 to 2035 will be very subdued. Those in our lowest socioeconomic group will lose the most ground compared with our pre-COVID scenario, with those individuals seeing a close to zero increase in life expectancy over the decade. In contrast our highest socioeconomic group will see improvements slightly in excess of the pre-COVID trend, albeit from a lower starting position, as their advantageous circumstances enables them to catch up some of the ground lost during the first part of this decade.



3.2.4 2035 and beyond

Following this period of close to zero growth in life expectancy at 65, we will see a return to the typical rate of mortality improvement seen during recent decades (around 1.5% pa). This is identical to our pre-COVID scenario.

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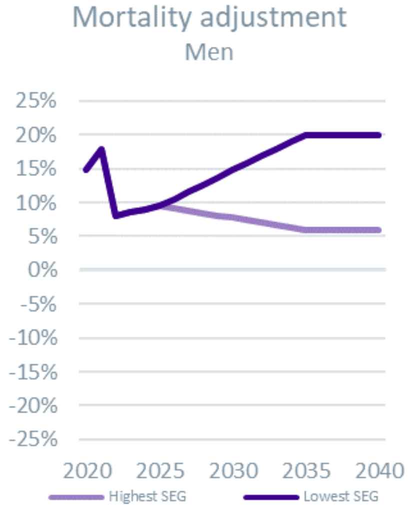
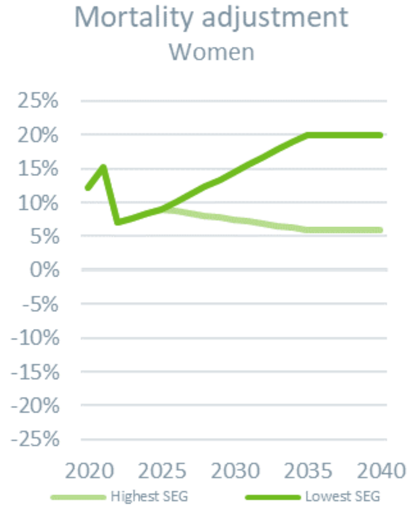
3.3 Mortality Uplifts applied (up to age 85)

The charts below show the cumulative mortality adjustment factor applied to pre-COVID expectations in each calendar year from 2020 for our highest and lowest SEG individuals.

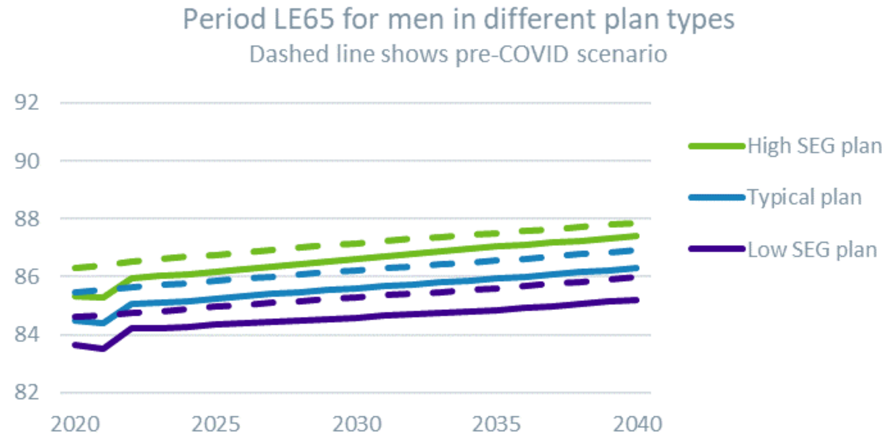
These uplifts apply at all ages up to age 85. For ages 86 and above, the adjustment applied is tapered in the same way that the long-term rate is tapered under the core CMI model.

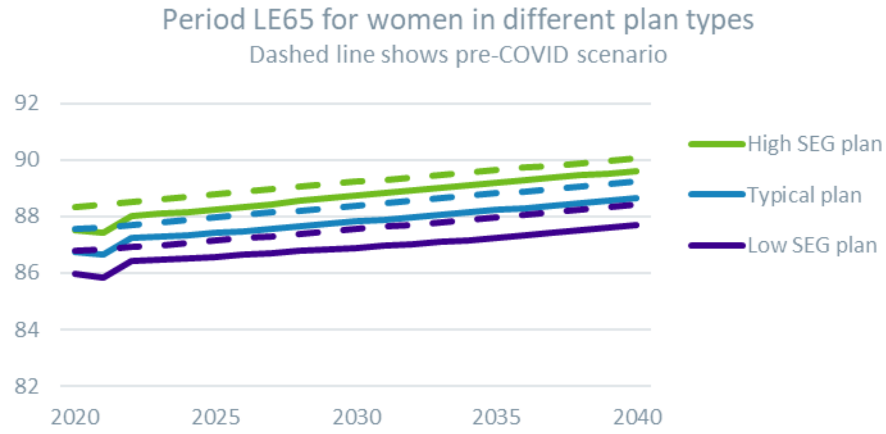




3.4 Projecting life expectancy under the scenario

The following charts show the pace of longevity improvement implied by the scenario for three different types of plan with different socioeconomic mixes, focussing on period life expectancy from age 65. We have also shown for comparison how life expectancy would be assumed to evolve under our pre-COVID scenario.





Scenario 4: Healthcare Decline

4.1 Description

Initial optimism around vaccines proves unfounded, with emerging new mutations limiting effectiveness and adverse publicity limiting uptake. We will continue to see persistent waves of excess COVID-19 mortality throughout the coming decade. 2021 will see mortality rates in excess of those seen during the first wave as hospital capacities are breached. Healthcare provision continues to be overwhelmed by each wave, with ongoing massive disruptions to non-COVID-19 medical treatments and no periods of catch up possible.

As the backlog becomes untenable, deficits build and as the economy continues to suffer, existing preventative measures (cancer screening services, health checks to spot cardiovascular disease and diabetes) are scaled back or increasingly rationed. This leads to a rise in conditions going undetected (or untreated if detected) and elevated mortality from cancers, heart disease and degenerative mental diseases over the coming decades.

An increasing proportion of individuals will reach retirement in poor health owing to untreated morbidities (including for some “long-COVID”), putting further strain on healthcare systems. Ultimately, COVID-19 will prove the catalyst which leads to high quality healthcare provision becoming increasingly a luxury item, leading to further growth in health inequality. Increases in life expectancy will stall or even go into reverse for some sections of the population.

4.2 How we modelled this scenario

4.2.1 Mortality Uplift for 2020

The scenario is identical to Bump in the Road.

4.2.2 Mortality Uplift for 2021

COVID-19 mortality over 2021 will be higher than that seen in 2020, with a significant third wave emerging during the year. Improvements in treatments and the impact of vaccination programs will be outweighed by the increased difficulties in controlling the spread of the virus due to short fallings in the effectiveness of vaccines, the ongoing emergence of new, more virulent strains for which vaccine programs are less effective and lockdown fatigue amongst the population.

In addition, the impact of delays in diagnosis and treatment will start to impact on mortality rates for other causes of death, meaning that the overall number of deaths during 2021 will be higher than in 2020.

Overall, mortality rates at the population level will be **25%** higher for men and **22%** higher for women than anticipated based on pre-COVID trends.

4.2.3 2022 to 2035

From 2022 we will see a lower level of direct COVID-19 deaths as vaccine programs are revised to address lessons learnt during 2021 and take full effect. Nevertheless, there will be significant residual excess mortality in relation to COVID-19 throughout the period due to vaccines not being sufficiently effective to fully remove the virus from circulation and as new strains emerge both in the UK and overseas. In addition, the impact of delays of diagnosis and treatment will continue to take hold.

The levels of anticipated mortality improvement that were baked-in to our pre-COVID projections go into reverse as the healthcare system becomes increasingly dysfunctional and health inequalities continue to grow as a result of an ongoing period of sluggish economic growth.

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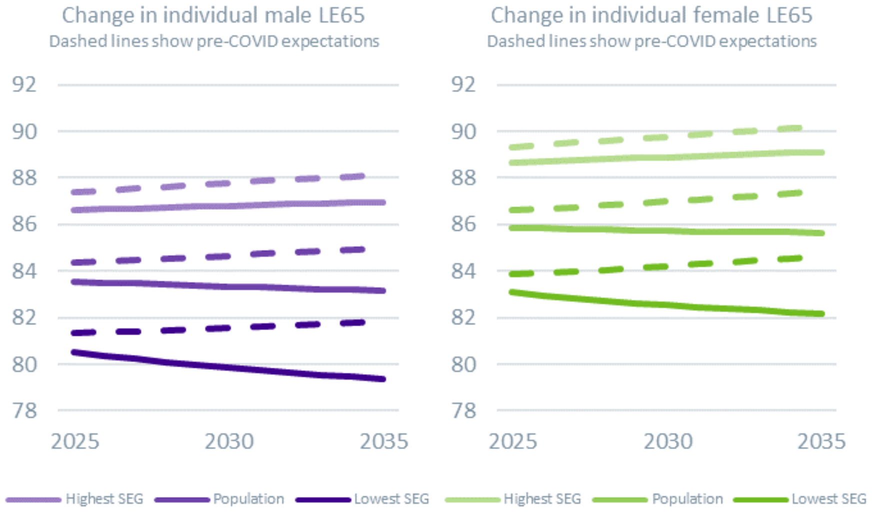
The assumed net impact of all these headwinds is that by 2035, population life expectancy will reduce over the ten years from 2025. Those in our lowest socioeconomic group will see the biggest decline compared with our pre-COVID scenario, with those individuals seeing a reduction around a year during that decade.



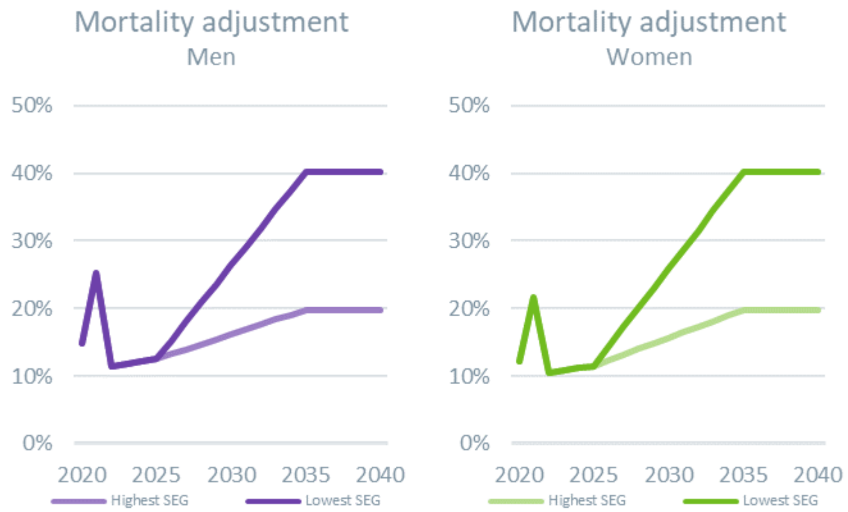
4.2.4 2035 and beyond

Following this period of reducing life expectancy, we will see a return to the typical rate of mortality improvement seen during recent decades (around 1.5% pa). This is identical to our pre-COVID scenario.

4.3 Mortality Uplifts applied (up to age 85)

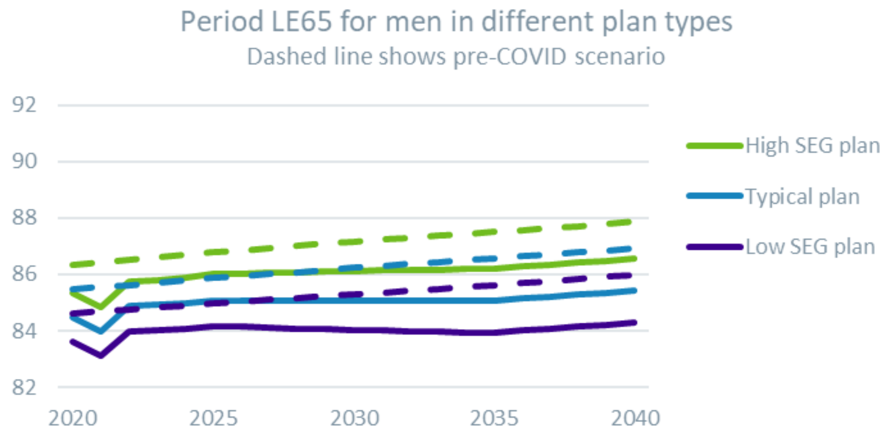
The charts below show the cumulative mortality adjustment factor applied to pre-COVID expectations in each calendar year from 2020 for our highest and lowest SEG individuals.

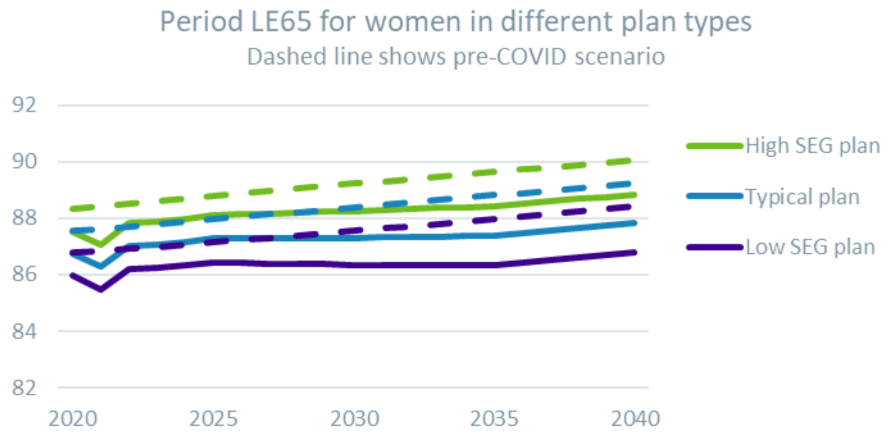
These uplifts apply at all ages up to age 85. For ages 86 and above, the adjustment applied is tapered in the same way that the long-term rate is tapered under the core CMI model.



4.4 Projecting life expectancy under the scenario

The following charts show the pace of longevity improvement implied by the scenario for three different types of plan with different socioeconomic mixes, focussing on period life expectancy from age 65. We have also shown for comparison how life expectancy would be assumed to evolve under our pre-COVID scenario.





Part Two: Illustrating the impact of the scenarios

Our Scenarios Paper describes the sensitivities of cashflows, liabilities and durations to each of our scenarios and how these vary between different scheme types.In this section we describe the wider modelling underlying the analysis described in that paper.

Step One: Identifying the age profile of a typical pension plan

We start by identifying the age profile (by accumulated pension amount) of a typical pension plan. To do this we look at the average age profile across plans in Club Vita. Details of this approach, and the resulting age profile for men and women are provided in **Section 2A**.

Step Two: Identify the socioeconomic mix of a typical pension plan, and an example lower and higher socioeconomic plan

The scenarios have aspects which impact the life expectancies of shorter- and longer-lived individuals differently. To capture the likely impact of these differential trends on pension plans we need to identify the socioeconomic mix of the members. We do this with reference to the variety seen across Club Vita. We also include an allowance that on a pension amount basis the age profile of any plan is likely to be skewed towards the more affluent groups compared to a pure headcount basis.

For simplicity our approach is to consider any plan to be a mix of “long lived high socioeconomics individuals” and “shorter lived low socioeconomics individuals”. This enables us to model each plan as having a mix of two types of people rather than incorporating the full diversity that we know exists. This is a simplification, and it is important to note that our higher SEG and lower SEG plans are designed to be “above” or “below” average respectively, rather than at the outer ends. As such **some plans with strong socioeconomic skews may see impacts for each scenario outside the range presented in our scenarios paper.**

The details of this allowance for different socioeconomic mixes is set out in **Section 2B**.

Step Three: Pre-COVID reference mortality assumption

In order to assess the impact of the different scenarios it is helpful to have a reference or benchmark assumption. Plans use a range of assumptions in practice, so for illustration we have used an assumption which is broadly in line with what we see many plans use as an approach to setting a best estimate assumption as part of their funding plan. We describe this “pre-COVID” assumption in **Section 2C**. The scenarios are all calibrated relative to this by applying the adjustments set out in Part One of this Technical Appendix.

Please note that this assumption is a proxy to an industry “typical best estimate” rather than representing a specific view of Club Vita.

Step Four: Simulating cashflows using reference individuals

In order to perform these calculations, we also need to make several other demographic assumptions, as well as financial assumptions. These are described in **Section 2D**. In that section we also describe how we simulate cashflows (and thus derive liabilities and durations) under a particular scenario by splitting a plan between the high and low socioeconomic reference individuals introduced in Step 2.

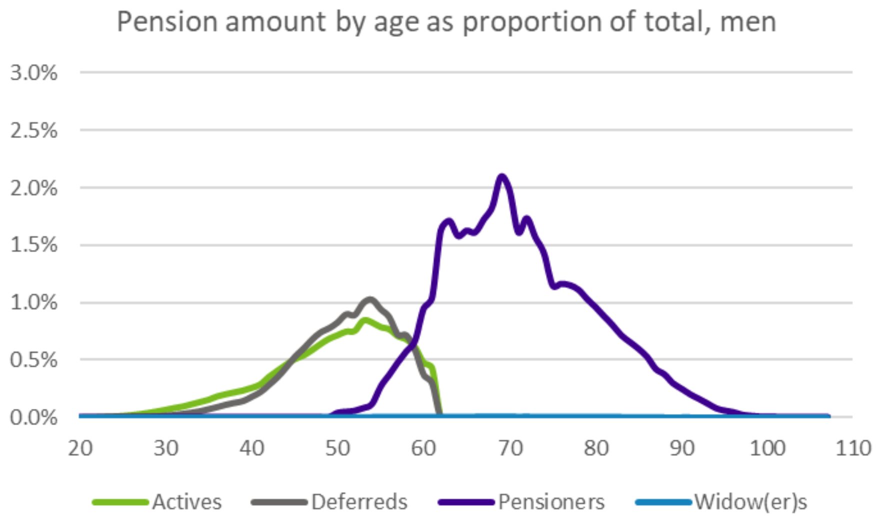
2A Age profile of our illustrative pension plan

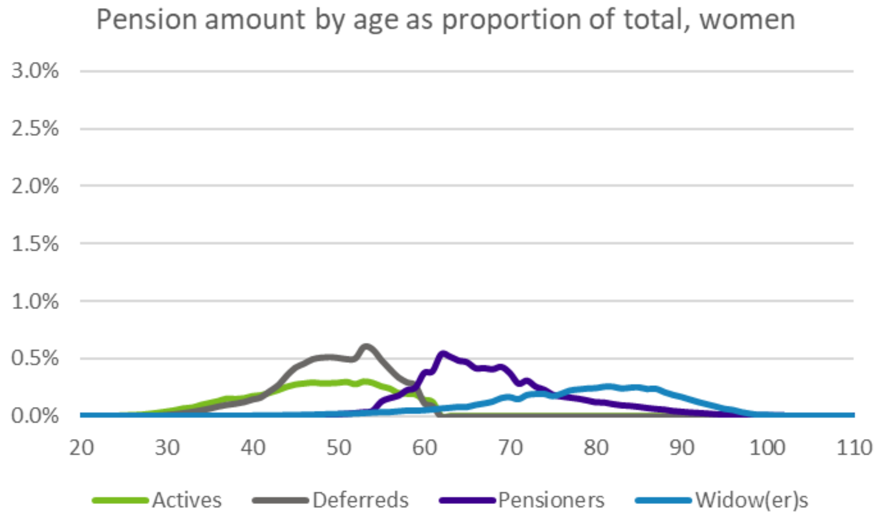
In order to estimate the impact of our scenarios in liability and cashflow terms, we have constructed an example plan whose properties are representative of a typical private sector plan within Club Vita. We have focussed on the private sector as most plans in this sector are closed and so have an older age profile. There are also differences in benefit structures which can influence the mix in liabilities across generations.

Our scenarios are equally relevant to open pension plans, e.g. those in the public sector. For those sectors the active and deferred liabilities will represent a larger proportion of the overall plan, and the cashflow duration will be longer. This gears up the impacts of the longer-term outlook in our scenarios and means that the **range of financial outcomes from our scenarios is likely to be broader for these plans**.

To generate our illustrative “typical” plan, we have taken a snapshot of the Club Vita dataset as at 1 January 2017 to build an archetypal plan which reflects the overall spread of membership divided by each of age, gender and status (active, deferred, pensioner, dependant). In building this plan we have also excluded pensioners below age 50, dependants below age 35 and non-pensioners outside of the age range 20 to 75 to ensure sensible age profiles. For non-pensioners aged over 62 we have treated them as retiring immediately and made allowance for pension commutation. We have also excluded individuals where the pension amount is missing or where our quality procedures suggest the pension amount supplied may be erroneous.

The charts to the right show the age distribution of our example plan weighted by pension amounts and split by gender and status. made. To help compare the relative sizes of the male and female data, the proportions are shown as a percentage of overall pension amount (across both men and women).





2B Creating plans with different socioeconomic mixes

Within our scenario analysis we consider the impact of the scenarios on three plans which we describe as “typical”, “low” and “high” socioeconomics.

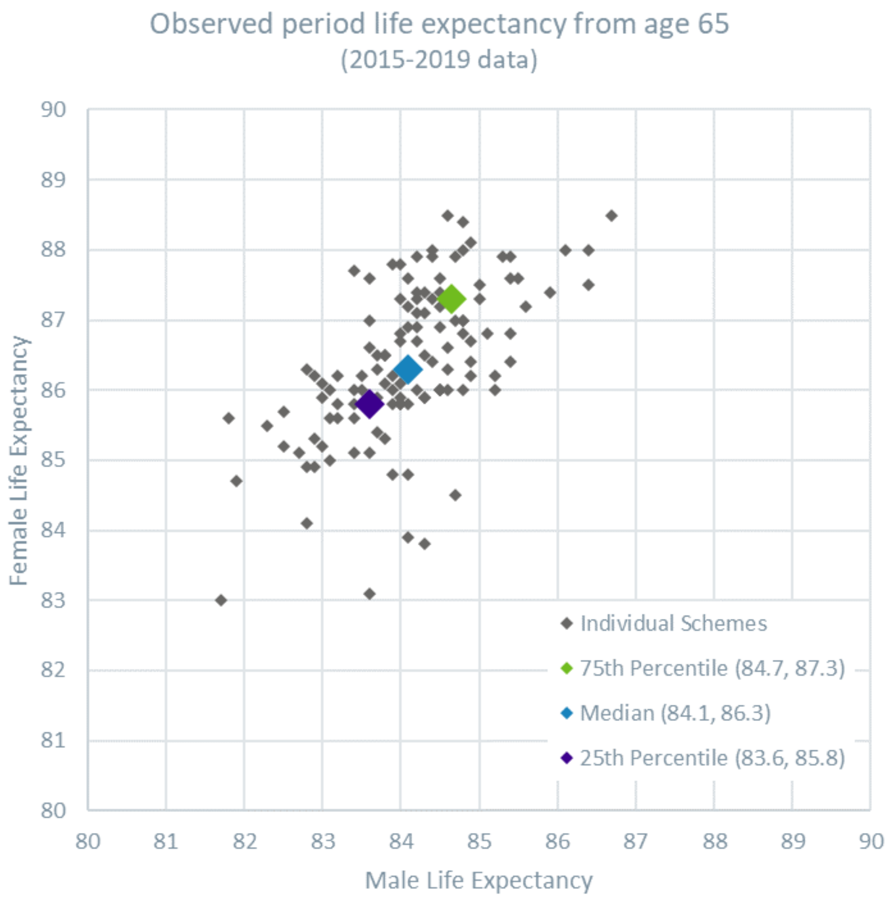
In creating these plans, we:

1. Identify *example plans* with above average, average, and below average socioeconomic mixes which are broadly representative of the bulk of plans (but not at the extreme ends of the spectrum)
2. Identify two *types of individual* who have high and low life expectancy and assign a mix between these individuals consistent with the overall life expectancy of the example plans. This enables us to model each of the plans as two subpopulations – i.e. a high and a low life expectancy group.
3. Adjust the mix identified in (2) to reflect that we care about the mix on a pension amounts rather than headcount basis, and that individuals with the larger individual pension amounts will be biased to the higher life expectancy group
4. Consider how the mix should vary by age to allow for a greater proportion of the higher life expectancy socioeconomic groups surviving to older ages

We set out our approach to each stage of this process in the rest of this section.

Stage 1: Example plans

We have calibrated our example plans with reference to the spread of life expectancies observed in Club Vita (in both public and private sector schemes). The chart to the right illustrates this spread for the plans for which we have enough data on during the period 2015-2019 to reliably measure life expectancy based on observed mortality rates *within* the plan.



We can see how the majority of plans have an observed (period) life expectancy for the 2015-2019 period of between 82 and 86 years for men, and 85 and 88 years for women (i.e. a 65 year old would be expected on average to live to those ages in the absence of future changes in mortality).

We have focussed on this “central belt” in identifying a reasonable life expectancy for a below average socio economics plan, a typical plan and an above average socioeconomics plan. We have used the 25th percentile, median and 75th percentile life expectancies highlighted in the chart as a guide, referring to these as “low”, “typical” and “high” socioeconomics respectively

It is important to note that there are also several plans where the life expectancies fall outside of this “central belt”. Low socioeconomics therefore should not be interpreted as the extreme and similarly for the high socioeconomics. There will be plans with greater exposure to the lowest / highest socioeconomics than our illustrative plans, and as such **the range of outcomes that individual plans may find when applying our scenarios could be broader than that presented in our scenarios paper.**

Stage 2: Using two types of individual to proxy these plans

The variety of life expectancies in the scatterplot reflect the variety of individuals within any given pension plan. Within Club Vita our “VitaCurves” provide detailed individual assumptions based on a member’s affluence, postcode, occupation, gender, etc.

For the purposes of the illustrative calculations presented here we have adopted a simplified approach rather than attempting to fully profile the pension plan. This simplified approach identifies individual’s representative of “high” and “low” ends of the longevity spectrum and models each plan as containing a mix of the two types of individual. By virtue of their life expectancy these individuals represent “high” and “low” socioeconomic groups. We therefore need to identify suitable “proxy” individuals, the mix between these for each plan, and how this mix should vary by age.

Proxy individuals

Club Vita’s VitaCurves longevity profiling tool, CV20, can discern a more than 10-year difference in life expectancy between male pensioners. The gap is slightly narrower for women at around 8.5 years. It makes sense therefore to pick proxy individuals from one of these tables.

The exact choice is not particularly important, so long as they have life expectancies comfortably above and below those of the “high” SEG plan and “low” SEG plan. The choice of VitaCurves used should also align with characteristics which would be associated with higher or lower socioeconomics. Ideally the chosen individuals would be above and below the national average life expectancy by a similar amount as then the population level life expectancy projection can be proxied as a 50:50 mix of the two types of individual.

For these purposes we use the single most differentiating predictor of life expectancy in our profiling tool, postcode. This captures a range of factors including individual lifestyle characteristics, local area socioeconomic deprivation and the higher affluence associated with longer-lived postcodes[4].Using this factor we can discern a 5 to 6-year difference in life expectancy between individuals living in our lowest postcode-based longevity group (A) and highest (H), This is significantly more than the range in life expectancies between our “high” and “low” socioeconomics plans.

[4] Our profiling tool identifies separately the impact of postcode and affluence and controls for the correlations between higher longevity postcodes and affluence. For the purposes of this modelling we have used the version which does not incorporate affluence and other factors, using the postcode as a proxy to both lifestyle and affluence.

Mix between proxy individuals (headcount basis)

The table below shows the life expectancy of the lowest and highest socioeconomic group ("SEG") individual. It also shows the implied split between these individuals for our three illustrative plans.

Population	Mix of Club Vita longevity groups *(headcount)*	Period life expectancy at 1/1/2017	
		Man aged 65	Woman aged 65
Low SEG individual	100% A	81.1	83.6
Low SEG plan	55% A : 45% H	83.6	85.8
Population[5]	50% A : 50% H	83.8	86.1
Typical plan	45% A : 55% H	84.1	86.3
High SEG plan[6]	30% A : 70% H	84.7	87.3
High SEG individual	100% H	86.6	88.5

Note: Life expectancies are shown for 2017 as this is the "as at date" of our latest VitaCurves. These are then roll-forward with the improvement rates under each scenario (which are identical for 2018 and 2019 under each scenario).

Stage 3: Adjusting the mix of proxy individuals for an amounts basis

The mixes calculated in Stage 2 provide an indicative mix on a *headcount* basis. However, for the purposes of projecting cashflows we need to allocate the pension amount distribution shown in Section 2A between longevity group A and longevity group H. Typically individuals with higher pension amounts are more likely (but not guaranteed) to be in our higher life expectancy postcode groups. As such we would expect a skew toward group H on a a pension amount rather than a headcount basis. Whilst this tends to vary depending on the diversity of individuals and pension amounts seen in a pension plan, it would not be unusual to that the life expectancy weighted by pension amount is around 1 to 1 ½ years for men and a bit over ½ a year for women. For lower SEG plans where there may be fewer large pensions the adjustment can be smaller.

For the purposes of generating the split of pension amounts between A and H we have assumed an additional 1-1.2 years of life expectancy for men (0.8 years for low SEG plans), and 0.6 years for women to derive (and sensibly round) the mix between A and H on an amounts basis. This leads to the splits and life expectancies shown in the table below.

Population	Mix of Club Vita longevity groups *(pension amount)*	Period life expectancy at 1/1/2017 *(amounts based)*	
		Man aged 65	Woman aged 65
Low SEG individual	100% A	81.1	83.6
Low SEG plan	40% A : 60% H	84.4	86.6
Typical plan	25% A : 75% H	85.2	87.3
High SEG plan	10% A : 90% H	86.0	88.0
High SEG individual	100% H	86.6	88.5

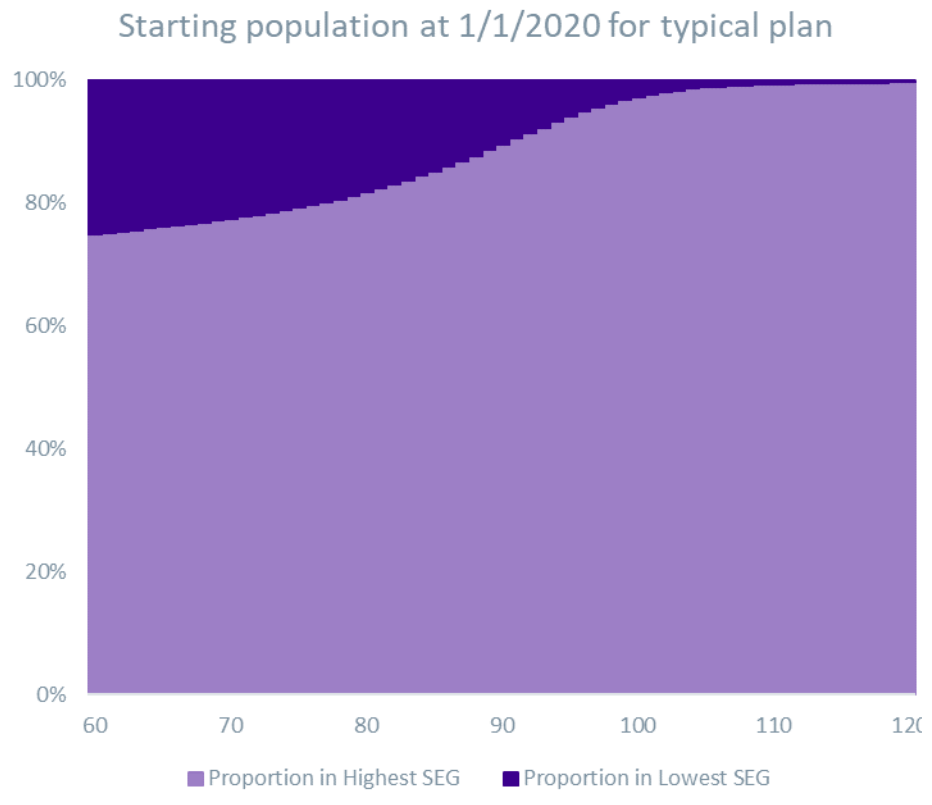
[5] These are very slightly higher than the observed UK population level life expectancies during 2017 (83.6 and 86.0 respectively), but a 50/50 split has been adopted for simplicity of approach.

[6] Split is average for men and women. (Men 35% A : 65% H; Women 25% A : 75% H)

Stage 4: Allowing the mix of proxy individuals to vary by age

The lower mortality rates amongst higher socioeconomic groups means that a greater proportion of individuals in these groups will survive to older ages. Consequently, there tends to be a shift towards the higher socioeconomic groups over the age spectrum.

To reflect this we assume that the proportions derived in Stage 3 apply at age 60 and allow for survivorship bias towards the high SEG individuals. As an example, we show in the chart below the resulting mix by age for men in our “typical” plan.



2C Pre-COVID reference improvement assumption

In order to project cashflows for the different plans we need mortality assumptions for our two groups of "proxy" individuals: longevity group A and H.

For all our scenarios we use a baseline assumption of our CV20 edition of VitaCurves, using the longevity group A and H tables for combined normal and ill health retirees for the pensioners, and the financial dependants' tables.

The COVID scenarios for improvements are calibrated as a series of adjustments to a pre-COVID reference improvement assumption. In each case they assume the same level of improvements in 2018 and 2019 as that reference assumption, before diverging from 2020 onwards.

The pre-COVID reference improvement assumption is designed to be a reasonable benchmark assumption which is broadly in line with the approach many plans have been using as a best estimate funding assumption prior to COVID.

Please note that this reference improvement assumption is intended as a proxy to an industry "typical best estimate" rather than representing a specific view of Club Vita

The assumption is based on the CMI projections model and uses the 2019 version of the model (i.e. using England & Wales data up to the end of 2019) with a long-term rate of improvement of 1.5%.

We have already seen that there is a large amount of variance amongst the current life expectancy of individuals and within pension plans. In recent years, an increasing focus has also been placed on the different rates of longevity improvement enjoyed by different sections of the population. Different studies have consistently shown that during the 2010s, individuals from less deprived backgrounds or with higher levels of pension have enjoyed higher rates of improvement than their less comfortable counterparts[7].

We have made an allowance for the expectation that different socioeconomic groups were expected to continue to see different rates of improvement in the short-term in our pre-COVID scenarios. We have allowed for this using the "extended version" of the CMI model where an adjustment can be made to the initial (starting) rates of improvement. This adjustment is generally referred to as the "A" parameter.

The A parameters have been set with reference to observed differential rates for different socioeconomic groups (for example Club Vita's VitaSegments and England & Wales Index of Multiple Deprivation deciles). We have made the values more extreme than those that would be supported by these datasets to reflect the more rarefied nature of the

[7] See https://www.clubvita.co.uk/collaborative-research/trends, https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-working-paper-144, https://www.health.org.uk/publications/reports/the-marmot-review-10-years-on.

"A" and "H" individuals compared with the published data. Specifically, for longevity group A we have used an A value of **-0.5%** and for longevity group H we have used an A value of **+0.75%.**

It should be noted that the expectation of a wider continuum of observed improvement rates across the socioeconomic spectrum is somewhat speculative, but the approach has been adopted to enable plausible and materially different values within the narrower range that we have considered within our specimen plan population.

The resulting improvement assumptions that we have made for our low and high socioeconomic "proxy" individuals (i.e. longevity groups A and H) are summarised in the table below.

Population	Male Improvements (pre-COVID)	Female Improvements (pre-COVID)
Longevity Group A	CMI_2019_M [LTR 1.5%; A=-0.50%]	CMI_2019_F [1.5%; A=-0.50%]
Longevity Group H	CMI_2019_M [1.5%; A=+0.75%]	CMI_2019_F [1.5%; A=+0.75%]

Implied A parameters for each type of plan

Our modelling approach of combining populations of longevity group A and longevity group H means that we do not need to explicitly set an improvement assumption for the illustrative plans. However, we can calculate implied A parameters for these populations based on the weighting of each plan (on an amounts basis) to each of A and H

Population	Implicit A parameter
Low SEG Plan	+0.25%
Typical Plan	+0.44%
High SEG Plan	+0.63%

2D Financial and other demographic assumptions

Financial Assumptions

For simplicity we have used a flat (rather than yield curve) assumption for escalating benefits and discounting these to present values. The assumptions adopted are intended to represent a reasonable reflection of the typical level of financial assumptions used by pension plans for funding assessments over the recent past rather than a snapshot of financial conditions at a point in time.

Assumption	Value used
Pension increases	2.5% pa
Deferred revaluation	2.5% pa
Discount rate (pre-retirement)	3.5% pa
Discount rate (post-retirement)	2.5% pa
Salary increases	3.5% pa

Demographic assumptions

In order to assess the future cashflows for our illustrative plans we also need to make several other demographic assumptions.

Mortality assumptions (pre-retirement)

No allowance is made for pre-retirement mortality.

Financial dependants assumptions

Assumption	Value used
Proportion of pension payable to financial dependant	50% of pre-commutation pension for deferreds, 50% of estimated pre-commutation pension for pensioners (assuming 20% commutation).
Proportion of individuals who have a financial dependant	80% of first lives have a financial dependant as at 1 January 2020
Gender of financial dependant	Opposite of first life
Age difference *(Difference between man and woman)*	3 years

Other assumptions

Assumption	Value used
Accrual Rate	1/60th
Normal retirement age	62
Treatment of those over NRA	Non-pensioners in the reference data who were over age 62 are treated as pensioners. Their expected commutation payment has been excluded from the cashflow calculations to avoid an artificial spike in cashflows during 2020.
Commutation proportion	20%
Commutation factor	20
Guarantee period	No allowance
Cashflow timing	Payments are assumed to occur once a year at the end of the year. Pension increases are also assumed to occur at the end of the year with the first payment receiving an increase.
Valuation date	All liability calculations have been performed with a calculation date of 1 January 2020

Simulating cashflows for the reference plans

The approach taken to building our High, Typical and Low pension plans has been to create mortality projections separately for our lowest and highest SEG individuals, create separate cashflow projections for each of these populations, and then create a weighted blend between these two projections for the population under consideration.

We then construct a separate set of cashflows for each subpopulation and add these together to construct the overall cashflows for the sample population in question.

This approach was adopted to enable us to more accurately model survivorship bias across different socioeconomic groups. For example, if COVID-19 had a far larger impact on mortality rates amongst lower SEGs (as measured as a multiple of expected mortality), then this methodology would allow for the change in population mix over time, unlike a more conventional approach which used weighted average mortality rates and a single projection. In practice, the evidence thus far suggests that COVID-19 has acted more as a mortality accelerator than a discriminator, with the increase in mortality rates **measured as a percentage uplift to expected mortality rates** being broadly similar across different socioeconomic groups.