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Society of Actuaries in Ireland

# The level of excess mortality in Ireland during the Covid-19 pandemic 2020 & 2021

Authors: Linda Daly, Mary Hall, Caroline Twomey and Karl Murray

**June 2024**

# Preface

The Society of Actuaries in Ireland ("the Society") is the professional body representing the actuarial profession in Ireland. The Society's Mission includes the following:

> To serve the public interest by contributing as an objective voice on matters where an actuarial perspective can add value.

In this context, the Society is pleased to present this report which has been authored by members of the Society's Demography Committee. Whilst this report provides a numerical analysis of the deaths experienced in Ireland in 2020/2021, the Society is very much cognisant of the people behind these numbers and is mindful of those who suffered the loss of a loved one during this period.

## Executive Summary

This report examines the level of excess all-cause mortality experienced in Ireland during the Covid-19 pandemic, offering some insights beyond the tally of reported Covid-19 fatalities. Focusing specifically on the first two years of the pandemic, 2020 and 2021, it examines excess deaths as a metric in understanding the pandemic's impact.

Excess mortality is defined as the difference between observed deaths and expected deaths. It is important to note that there is not one definitive approach to calculating excess mortality – mainly because, whilst observed deaths will ultimately be a matter of record (i.e. they are objective), the calculation of expected deaths is dependent on the choice of methodology (i.e. it relies on professional judgement). This analysis is based on a methodology that relies on past experience as a benchmark for expected deaths. As presented in this report, different past periods for estimating expected deaths result in varying levels of excess mortality.

A common approach during the Covid-19 pandemic, which allowed for timely estimates of excess mortality, was to calculate expected deaths as the average of the annual deaths in a preceding number of years. However, this methodology is subject to distortion in times of rapid population changes (e.g. population growth, population aging, mortality improvements). As set out in sections 1 and 2, the Irish population was subject to such changes in the relevant years, and this should be reflected in the calculation of excess mortality during the pandemic. A more appropriate methodology, which allows for these population changes, is to base the excess mortality calculation on Age Standardised Deaths. This approach is described in detail in section 3. In summary, it takes the actual deaths by age for each year, and reproportions them to reflect what they would be if the population had the same size and age distribution every year. In this manner, the distorting effect of changes in population is removed.

The benchmark period chosen in this study is based on the three years preceding the pandemic (2017-2019). As discussed in the report, this period is selected due to its proximity to the pandemic years and its representation of pre-pandemic mortality trends, providing a relevant basis for estimating expected deaths in 2020 and 2021. The deaths were standardised to the population size and mix of 2021.

Under this methodology, the analysis reveals broadly no excess mortality in 2020, indicating relatively stable mortality compared to the pre-pandemic years of 2017-2019. However, 2021 witnessed an increase in excess mortality, signalling a more significant impact on mortality patterns during the pandemic's second year. Cumulatively, Ireland experienced c.1,100 excess deaths during the pandemic years of 2020 and 2021. That figure underscores the toll imposed by the pandemic on the nation's population and such insights are important for understanding the broader mortality implications of the pandemic beyond reported Covid-19 fatalities.

A reader observing the significant downward trend in mortality from 2010-2019 (see Figure 3), might reasonably expect that, in the absence of Covid-19, the trend would have continued into 2020-2021 resulting in lower expected deaths and hence a higher number of excess deaths or higher excess mortality. However as stated above, we opted to calculate the expected mortality for 2020 and 2021 by using the average observed mortality from 2017 to 2019. This method is objective as it relies on actual recorded data from those years.

# 1. Introduction

Ireland has experienced significant improvements in mortality since the start of the 21st century with total life expectancy at birth increasing by over six years between 2000 and 2019 (Eurostat 2024). However, these rapid mortality improvements were brought to an abrupt halt by the onset of the SARS-Cov-2 (Severe Acute Respiratory Syndrome Coronavirus 2), commonly referred to as Covid-19, pandemic in early 2020. This report investigates the impact of the Covid-19 pandemic on mortality in Ireland in 2020 and 2021 and builds on previous work carried out by the Society of Actuaries Covid-19 Action Group (COVID-19 Action Group Blog | Society of Actuaries in Ireland).

According to research by the World Health Organisation (WHO) Covid-19 resulted in an estimated 14.9 million excess deaths worldwide in 2020 and 2021 (WHO 2022). Recent research on the impact of Covid-19 on mortality in Ireland has been contradictory. For example, a report by the OECD (OECD 2023) indicated that Ireland did not experience excess mortality during the pandemic years 2020-2022. In contrast, analysis by the Central Statistics Office (CSO) (CSO 2022) indicated 3,533 excess deaths in Ireland over the period 2020-2021. In both these cases, the research was based on different data sources (provisional CSO data for the OECD report and data from the website RIP.ie for the CSO analysis which was completed in advance of the alternative data becoming available), covered different time periods and employed different methods for calculating excess mortality. Research on the impact of Covid-19 on mortality in Ireland has been hampered by the delay in obtaining timely, official statistics on Irish mortality during the pandemic (CSO Information Note). The delay in obtaining official mortality statistics for 2021 was further exacerbated by the impact of the HSE cyber-attack in May 2021 on death registrations. Finalised death data for Ireland for 2021 was made available by the CSO towards the end of 2023 and is used in our analysis.

Analysis of all-cause excess mortality is the most common approach for assessing the impact of the Covid-19 pandemic on mortality and allows assessment of both the direct and indirect effects (e.g. reduced access to healthcare, reduction in traffic accidents) of the pandemic on mortality. Excess mortality is calculated by comparing the observed number of deaths during the pandemic with the number of deaths that would have been expected to occur in the absence of the pandemic. The expected number of deaths is based on the deaths which occurred over a similar, benchmark or baseline period, immediately prior to the pandemic. Therefore, the accuracy of the excess mortality calculations is dependent on the appropriateness of the chosen benchmark period and the consideration of any potential adjustments needed to account for changes in population size and demographics over time.

The choice of the benchmark period requires careful consideration to ensure that the resulting mortality figures accurately reflect the underlying trends and patterns in the population. This report considers three benchmark periods for calculating excess mortality in 2020 and 2021 during the Covid-19 pandemic – the 3-year period 2017-2019, the 5-year period 2015-2019 and the 10-year period 2010-2019. Excess mortality is calculated for males and females combined in the main body of the report while results by gender are presented in the Appendix 1.

The report is organised as follows: Section 2 discusses the data used in the analysis, Section 3 describes the approach used to determine excess mortality for 2020 and 2021 and presents the results, while Section 4 concludes with a brief discussion of the results. Appendix 2 examines the variability inherent on the methodology assumed in this report.

## 2. Data

Death and population data for the pandemic years 2020 and 2021 was obtained from the Central Statistics Office (CSO) Ireland aligning with the data provided on the CSO website as of March 2024. As the death data for 2022 had not been finalised when this report was written, this analysis solely focuses on excess mortality in the years 2020 and 2021. Additionally, to establish an appropriate benchmark period for evaluating the extent of excess mortality during the Covid-19 pandemic, it was necessary to obtain death and population data for the 10-year period preceding the pandemic (2010-2019) which was also sourced from the CSO.

Data on the number of deaths split by gender, year (2010-2021) and by single year of age to age 98 and for ages 98+ combined were provided. The death data is based on the date of occurrence and is finalised data. Corresponding population estimates were also provided. The CSO calculates annual population estimates by projecting forward the relevant census population and subtracting vital events and migration flows. The annual population figures for 2017-2021 were revised by the CSO from previous estimates following a detailed analysis of the 2022 census results. The annual population estimates have an effective date of the 1st April and are assumed to approximate mid-year population estimates.

Figures 1 and 2 present the annual number of deaths and population estimates respectively for ages 0-64 and 65+ over the period 2010-2021. From Figure 1 we can see that there was little change in the number of deaths aged 0-64 over the period 2010-2021. In contrast, the number of deaths over age 65 shows a gradual rise during the period from 2010 to 2019, with more notable increases observed in 2020 and 2021. Figure 2 shows a gradual increase in the overall population from 2010 to 2015, amounting to a 2.9% rise over this 5-year period. However, a more substantial increase occurred after 2015. Specifically, the overall population witnessed a c.7% growth (around 342,000 individuals) over the 5-year period 2015-2020.

Breaking the population growth down by age group showed that, over the 5-year period 2015-2020, the population aged 0-64 increased by approximately 6% while the population aged 65+ increased by approximately 19%. Furthermore, during the pandemic (from 2020 to 2021), there was a 2.9% increase in the population aged 65+. Additionally, while not shown in the graphs we noted that the population aged 85+ increased by approximately 16% over the period 2015-2020 with a further increase of 2.6% from 2020-2021. This rapid increase in the population aged 85+ added to the challenges posed by the Covid-19 pandemic, as the Covid-19 virus disproportionately impacted older individuals compared to their younger counterparts (Williamson et al. 2020).

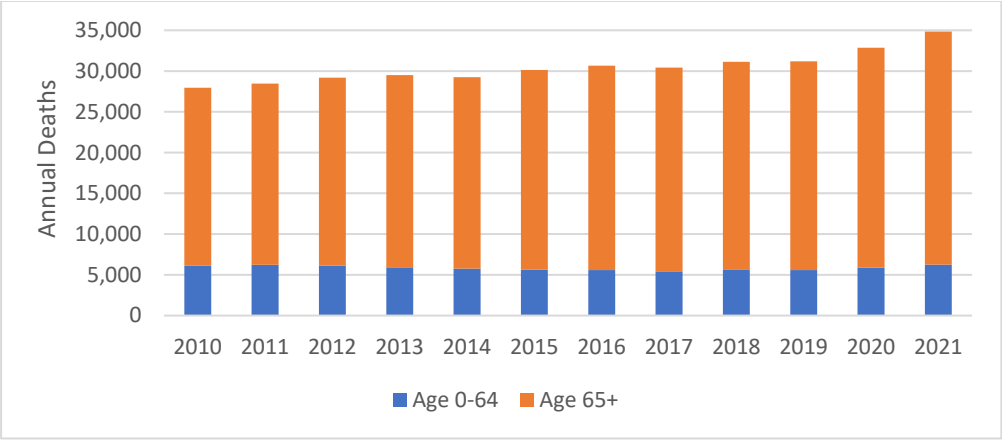


Figure 1: Number of Deaths for age group 0-64 and 65+ over the period 2010-2021.

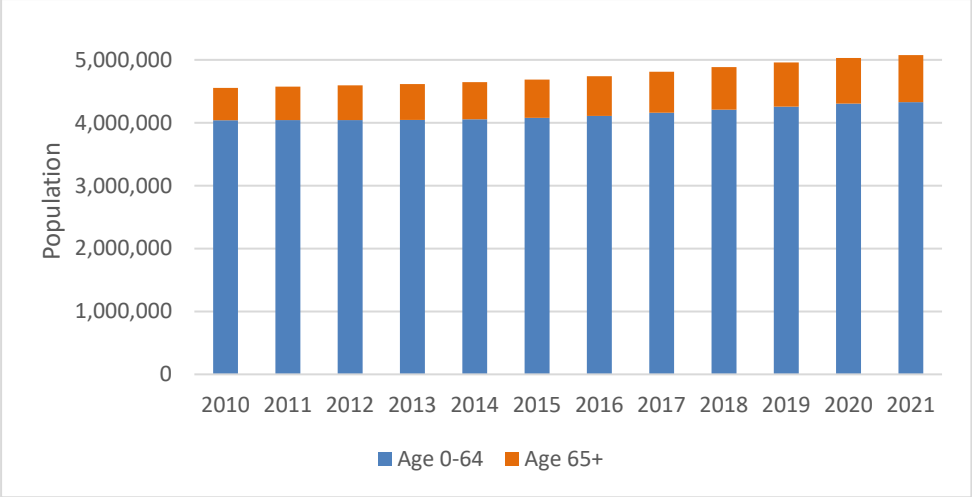


Figure 2: Population for age group 0-64 and 65+ over the period 2010-2021.

## 3. Age Standardised Excess Deaths in 2020 and 2021

To allow for changes in the age structure of the population over time it is necessary to standardise the annual deaths prior to calculating the excess mortality (Curtin & Klein, 1995). Age Standardised Mortality Rates (ASMRs) allow for mortality comparisons between populations with different age structures and the standardised deaths were calculated based on ASMRs by single year of age to age 94 and for ages 95+ combined, standardised relative to the 2021 population for Ireland. The resulting standardised deaths for each year reflect the deaths that would have occurred in each year if the population in that year matched the population in 2021 (the standard population).

Figure 3 presents the trend in the standardised deaths over the period 2010-2021. In general, the standardised deaths declined over the pre-pandemic period 2010-2019 (indicating mortality improvement over the period) though the rate of decline varied over time. The 3-year benchmark period 2017-2019 experienced an annualised decline in standardised deaths of approximately 2.5% per annum compared to annualised declines of only 1.7% per annum for the 5-year benchmark period 2015-2019 and 1.6% per annum for the 10-year benchmark period 2010-2019. The standardised deaths for 2020 and 2021 show consecutive increases compared to the 10-year low observed in 2019.

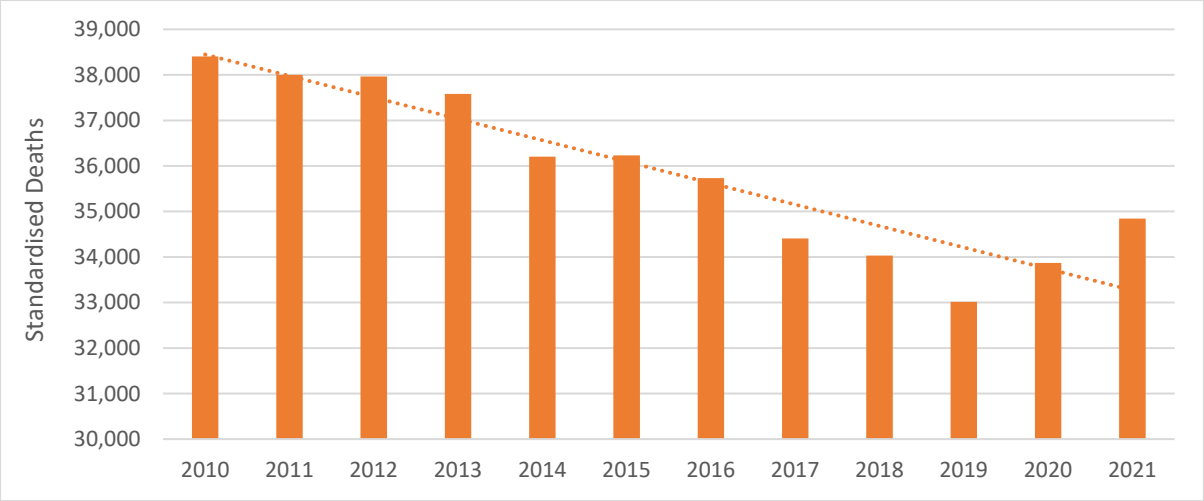


Figure 3: Standardised deaths for the period 2010-2021 – standardised relative to the 2021 population.

Table 1 presents the average annual standardised deaths for the respective benchmark periods.

| Benchmark | Time Period | Average Annual Standardised Deaths |
|---|---|---|
| Benchmark 1 | 2017-2019 | 33,818 |
| Benchmark 2 | 2015-2019 | 34,684 |
| Benchmark 3 | 2010-2019 | 36,158 |

Table 1: Average Annual Standardised Deaths for the benchmark periods listed.

Figure 4 compares the standardised deaths experienced in 2020 and 2021 with the average annual standardised deaths for the 3-year, 5-year, and 10-year benchmarks. For 2020, the standardised deaths fall below the 5-year and 10-year benchmarks while broadly aligning with the 3-year benchmark. This suggests little or no excess deaths occurred in 2020 under any benchmark. However, in 2021, the standardised deaths significantly surpass the 3-year benchmark, fall below the 10-year benchmark, and marginally exceeds the 5-year benchmark. This indicates a nuanced situation for 2021, no excess deaths are observed when using a 10-year benchmark, significant excess deaths are

evident with a 3-year benchmark, and marginal excess deaths are observed when using a 5-year benchmark. Therefore, it is apparent that the choice of benchmark period significantly influences the level of excess mortality during the Covid-19 pandemic.

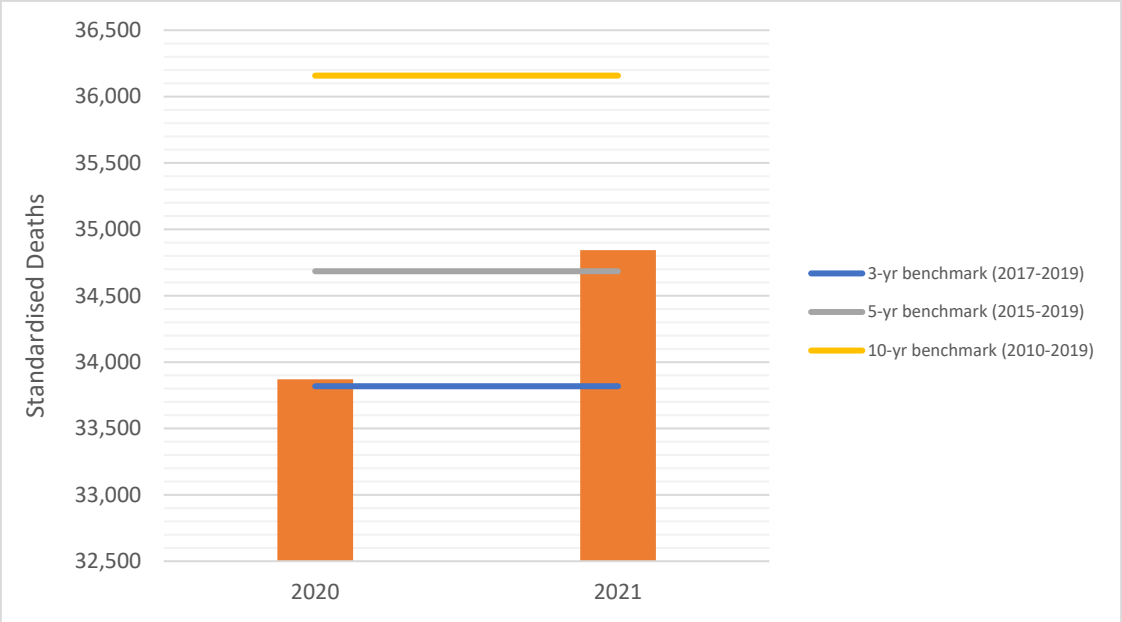


Figure 4. Comparison of the standardised deaths for 2020 and 2021 with those of the benchmark periods shown.

All else being equal, in prediction exercises, the inclusion of more experience data (in this case, years) strengthens the statistical significance of a benchmark. However, the significant downward trend in mortality observed in the period 2010 to 2019, renders the earlier years less useful as a predictor of mortality in 2020 and 2021. We believe the 3-year benchmark from 2017 to 2019 represents a reasonable balance between volume of experience data and proximity to the Covid-19 pandemic. Consequently, all subsequent analyses are based on the 3-year benchmark period 2017-2019.

Table 2 presents the excess deaths for 2020 and 2021 as the difference between the standardised deaths for 2020 and 2021 (the actual deaths) and the standardised deaths for the benchmark period 2017-2019 (the expected deaths). Under this approach, both 2020 and 2021 register an increase in excess mortality though the increase in 2020 is small. The results demonstrate that Ireland experienced approximately 1,100 excess deaths over the two-year period.

| | Standardised Deaths | Average Annual Standardised Deaths for 2017-2019 | Excess Deaths |
|---|---|---|---|
| **2020** | 33,870 | 33,818 | 52 |
| **2021** | 34,844 | 33,818 | 1,026 |
| **Total Excess Deaths for 2020 + 2021** | | | **1,078** |

Table 2. Excess deaths in 2020 and 2021 (adjusted for population differences) relative to the benchmark period 2017-2019.

It should be noted that aside from the subjectivity in determining an appropriate benchmark period to use in calculating the expected deaths, there are further approximations in the calculation of excess deaths, due to, for example:

- annual mortality rates being subject to random fluctuations (partially due to the relatively small population size for Ireland)
- the aggregation of data beyond age 95
- the use of population estimates as opposed to actual population numbers.

It could be considered a more accurate approach to calculate the excess deaths in 2020 by using standardised deaths relative to the population for 2020. However, doing so resulted in only minor differences to the figures quoted above and did not affect the overall estimate of approximately 1,100 excess deaths for Ireland over the two-year period 2020 and 2021.

### 3.1 Age Standardised Excess Deaths by Age Group

The Covid-19 pandemic primarily impacted the elderly population, warranting a more thorough analysis of this demographic. Figure 5 presents the standardised deaths in 2020 and 2021 for the three age groups: 0-64, 65-84, and 85+, relative to the corresponding average annual standardised deaths for the 3-year benchmark period 2017-2019. As can be seen, age groups 0-64 and 85+ experienced excess mortality in both 2020 and 2021 while age group 65-84 only experienced excess mortality in 2021. The excess deaths in 2020 for ages 0-64 and 85+, and in 2021 for ages 65-84, were relatively small and could be due to normal fluctuations. Furthermore, individuals aged 65-84 make up only a small proportion of the population (around 13% in 2021), making them particularly prone to random variations (see Appendix 2 for more information).

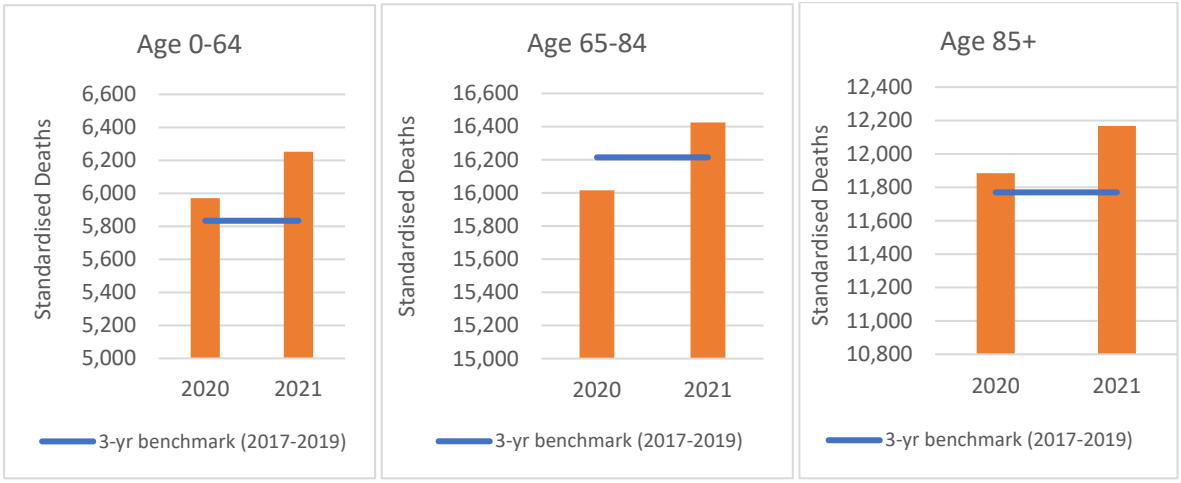


Figure 5. Comparison of the standardised deaths by age group for 2020 and 2021 with those of the benchmark periods shown.

Table 3 presents the excess deaths for each age group in 2020 and 2021. The excess deaths are calculated using the method described in the preceding section. As expected, individuals aged 85+ had the highest excess deaths as a percentage of population (0.147% and 0.512%) for both 2020 and 2021, despite individuals aged 0-64 having the highest absolute number of excess deaths (137 and 418) in those respective years.

| | Excess Deaths | | | | Excess Deaths expressed as a % of the 2021 population per specific age group | | | |
|---|---|---|---|---|---|---|---|---|
| | **0-64** | **65-84** | **85+** | **All Ages** | **0-64** | **65-84** | **85+** | **All Ages** |
| **2020** | 137 | -199 | 114 | 52 | 0.003% | -0.030% | 0.147% | 0.001% |
| **2021** | 418 | 211 | 397 | 1,026 | 0.010% | 0.031% | 0.512% | 0.020% |

Table 3. Excess deaths in 2020 and 2021 (adjusted for population differences) by age group relative to the benchmark period 2017-2019.

## 4. Conclusion

The results presented in section 3 above show that excess deaths in Ireland during the Covid-19 pandemic were higher in 2021 compared to 2020. Among various possible contributing factors to the lower excess death in 2020, government-imposed restrictions stand out as one potentially significant factor. The Oxford Coronavirus Government Response Tracker (OxCGRT) conducted an evaluation of stringency indices for numerous countries amidst the Covid-19 pandemic. This index amalgamated nine response metrics, encompassing factors such as school closures and stay-at-home directives (Mathieu et al, 2020). Furthermore, it was weighted according to the percentage of vaccinated individuals within each population. This daily-calculated index represents the average score of the nine metrics, each graded on a scale from 0 to 100. A higher score signifies a more rigorous response, with 100 denoting the most stringent level of measures implemented.

Figure 6 presents the stringency index for Ireland throughout 2020 and 2021. As depicted in the graph, the index was set to zero during January and February 2020, reflecting the absence of restrictions until 12 March 2020. From 12 March to 31 December (the overlapping periods of the 2020 and 2021 index), it is evident that significantly stricter measures were implemented in 2020 compared to 2021. This is supportive of the argument that the stringent Covid-19 restrictions employed in 2020 were effective in containing deaths.

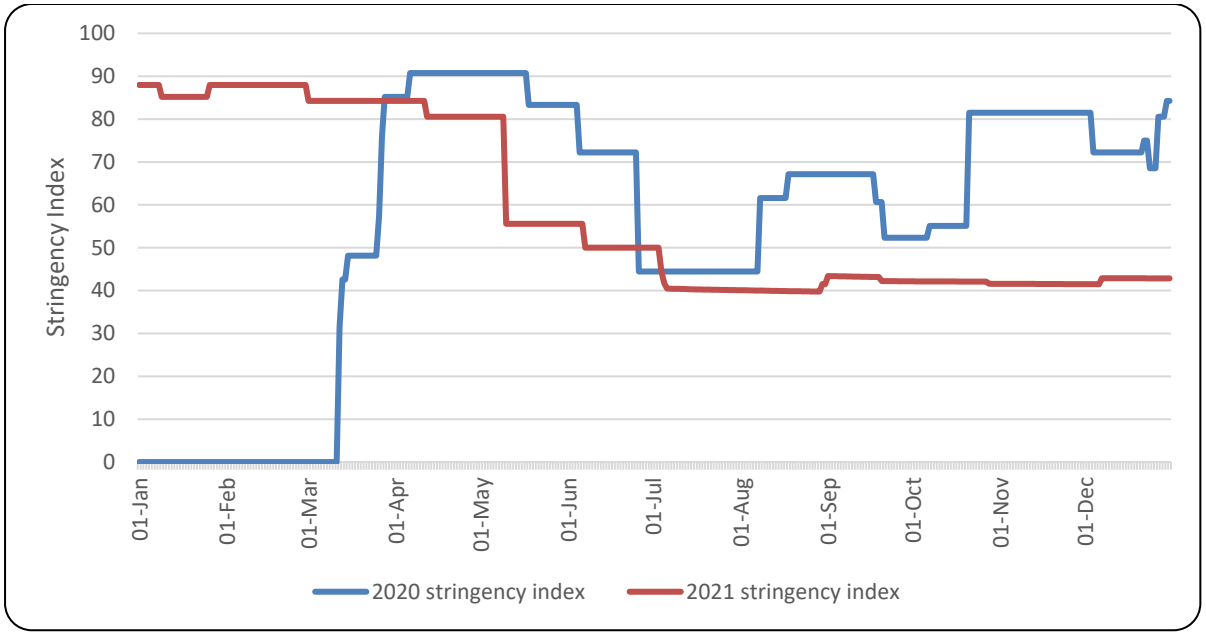


Figure 6. Stringency Index values for 2020 and 2021 for Ireland.

In conclusion, our analysis reveals a contrast in Ireland's mortality trends between 2020 and 2021 when assessed against the 3-year benchmark period immediately prior to the pandemic. For all ages

combined excess deaths were observed in 2021 while only marginal excess deaths were observed in 2020. As expected, the oldest age group (aged 85+) experienced the highest proportional excess mortality in both years. Notably, we based our assessment on the 3-year benchmark period of 2017-2019 which we deemed to be the most appropriate benchmark due to significant mortality improvements experienced during this period. The absence of excess deaths indicated by the 5 and 10-year benchmarks could be attributed to these benchmarks not fully reflecting the recent mortality advancements preceding the pandemic.

It is important to note however, that this analysis does not attempt to estimate what expected deaths might have been in 2020 and 2021 had the significant downward trend in mortality rates observed in the period 2010-2019 continued. It is reasonable to assume that such an exercise would indicate that the pandemic did result in higher than expected deaths in 2020 and a more significant impact in 2021 than suggested by the methodology outlined in section 3. Thus, it is crucial to carefully evaluate and consider the methods used when interpreting death trends and excess deaths during the Covid-19 pandemic.

Covid-19 is expected to become endemic in the population and the long-term impact of Covid-19 on future mortality is uncertain. The negative effects of delayed medical diagnoses and treatment during the pandemic and the impact of post Covid conditions (e.g. long Covid) on mortality will emerge slowly. In contrast, factors such as improved vaccine effectiveness, greater public health awareness and an increased focus on monitoring and improving care for the elderly could positively impact on future mortality trends.

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## Appendix 1: Gender Specific Excess Mortality

Figures 7 and 8 present the trends in the standardised deaths for males and females respectively for the period 2010-2021.

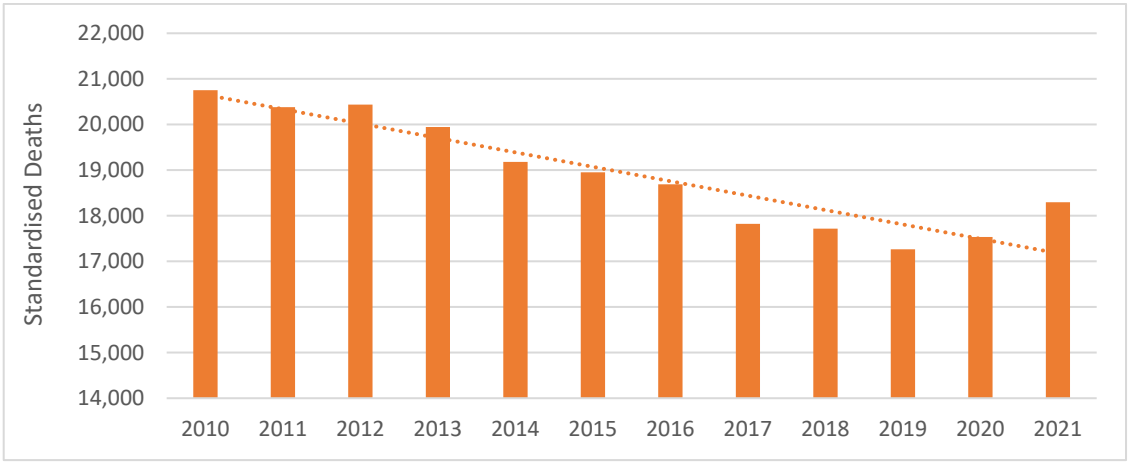


Figure 7. Standardised deaths for males for the period 2010-2021 – standardised relative to the 2021 male population.

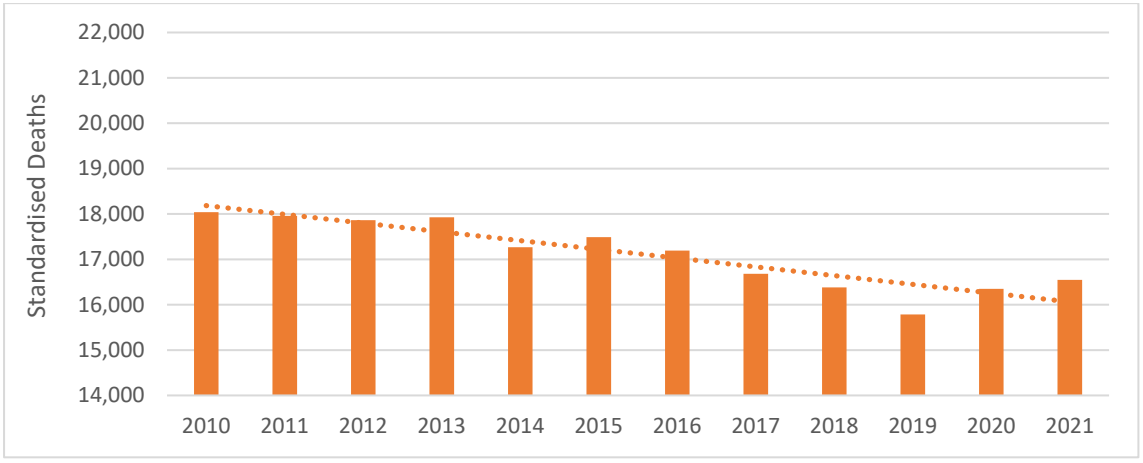


Figure 8. Standardised deaths for females for the period 2010-2021 – standardised relative to the 2021 female population.

Tables 4 and 5 present the excess deaths for 2020 and 2021 for males and females respectively. As before, the excess deaths are calculated as the difference between the standardised deaths for 2020 and 2021 (the actual deaths) and the standardised deaths for the benchmark period 2017-2019 (the expected deaths). Please note that the total excess deaths for males and females as shown in Table 4 and Table 5 do not match the total presented in Table 2 due to the averaging implied by using a combined population for males and females relative to the gender specific populations used in Tables 4 and 5.

| | Standardised Deaths | Average Annual Male Standardised Deaths for 2017-2019 | Excess Deaths |
|---|---|---|---|
| **2020** | 17,533 | 17,602 | -69 |
| **2021** | 18,296 | 17,602 | 694 |
| | | | |
| **Total Male Excess Deaths for 2020 + 2021** | | | **625** |

Table 4. Excess male deaths in 2020 and 2021 (adjusted for population differences) relative to the benchmark period 2017-2019.

| | Standardised Deaths | Average Annual Female Standardised Deaths for 2017-2019 | Excess Deaths |
|---|---|---|---|
| **2020** | 16,351 | 16,282 | 69 |
| **2021** | 16,548 | 16,282 | 266 |
| | | | |
| **Total Female Excess Deaths for 2020 + 2021** | | | **335** |

Table 5. Excess female deaths in 2020 and 2021 (adjusted for population differences) relative to the benchmark period 2017-2019.

## Appendix 2: Understanding Variability

The variability of a country's death tolls naturally fluctuates from year to year. Figure 3 indicates that although mortality rates have generally improved over the past two decades, they haven't followed a consistent linear trend - for example, standardised deaths slightly increased in 2015 compared to the preceding year, 2014. This prompts consideration: Could the excess deaths reported earlier in this report be due to normal fluctuations rather than solely attributed to the Covid-19 pandemic?

Figure 9 shows the standardised deaths in 2020 and 2021 for all ages, along with expected deaths based on a 3-year benchmark. It also includes dashed lines representing the 95% upper and lower confidence intervals calculated assuming deaths follow a Poisson distribution as per appendix 3.3 of CMI working paper 97 (CMI Working Paper 97) . The marginal level of excess deaths estimated for 2020 fall within this interval, indicating they lie within the realm of normal variability. However, in 2021, the excess deaths surpass the upper confidence interval, indicating that the elevated death toll in 2021 cannot be attributed to typical fluctuations but rather indicates a genuine increase in mortality under the stated methodology employed in this report.

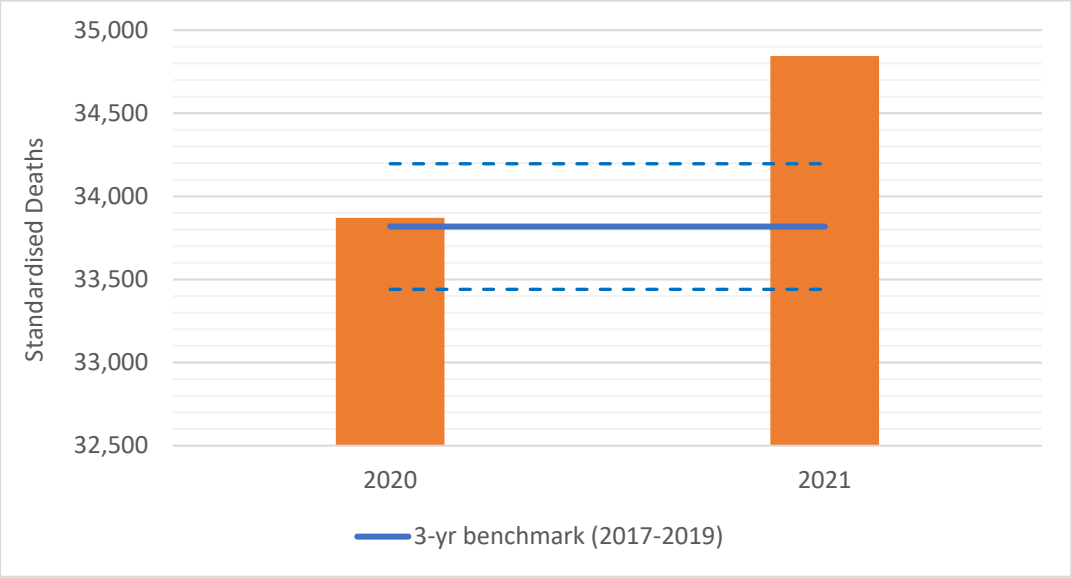


Figure 9. Comparison of the standardised deaths for the years 2000-2021 for all ages along with the corresponding 3-year benchmark and 95% upper and lower confidence intervals.

Figure 10 shows the standardised deaths in 2020 and 2021 by age group, along with expected deaths based on a 3-year benchmark. Again, it includes dashed lines representing the 95% upper and lower confidence calculated similarly to those in Figure 9. The marginal level of excess deaths estimated for 2020 for all 3 age groups fall within this confidence interval, indicating they lie within the realm of normal variability. However, in 2021, the excess deaths surpass the upper confidence interval for age groups 0-64 and 85+, indicating that the elevated death toll in 2021 cannot be attributed to typical fluctuations but rather again indicates a genuine increase in mortality. For those aged 65-84, while there were excess deaths in 2021, they fall within the confidence interval. This group make up a smaller proportion of the population (about 13% in 2021) and because they are a smaller group, their numbers can fluctuate more. So, any excess deaths in 2021 for this age group might just be due to this natural variation.

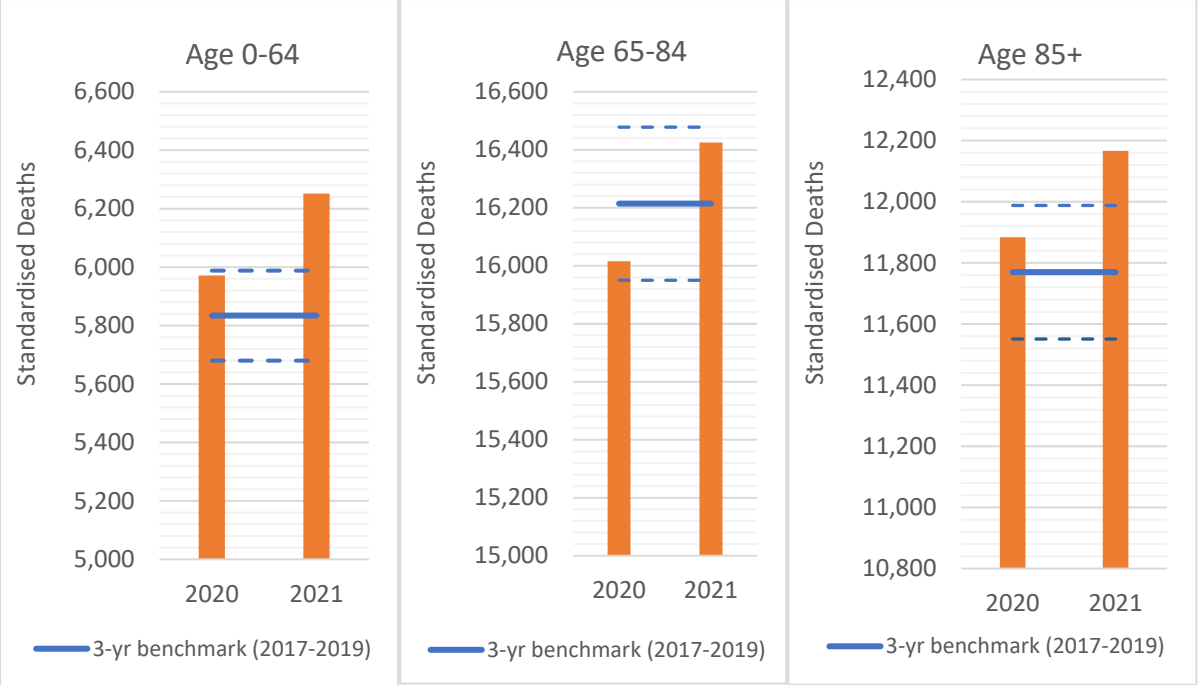


Figure 10. Comparison of the standardised deaths by age group for the years 2020 and 2021 with the corresponding 3-year benchmark and 95% upper and lower confidence intervals.

It should be noted that for 2020, the analysis is based on the 12-month period January-December 2020. The analysis for 2020 based on the pandemic period March-December 2020 showed the excess deaths for age group 85+ were outside the upper confidence interval for the 3-year benchmark period shown. This indicates the excess deaths for this age group were significant for 2020 over the 10-month period. However, excess deaths for the younger age groups 0-64 and 65-84 over the 10-month period rather than the 12-month period were reduced thus there were no excess deaths overall for the 10-month period in 2020.