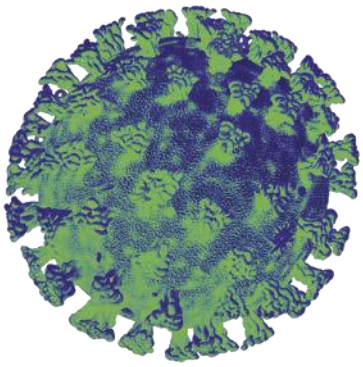
Llywodraeth Cymru
Welsh Government

Technical Advisory Cell

Health inequalities in COVID-19 deaths and hospital admissions in Wales, from March 2020 to July 2022



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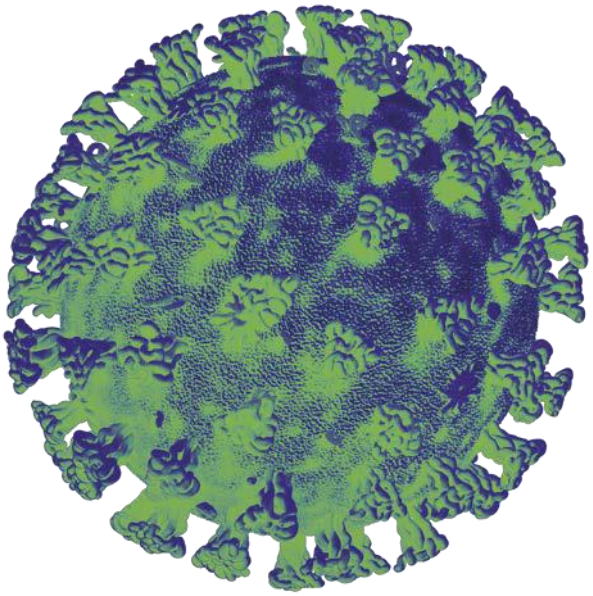
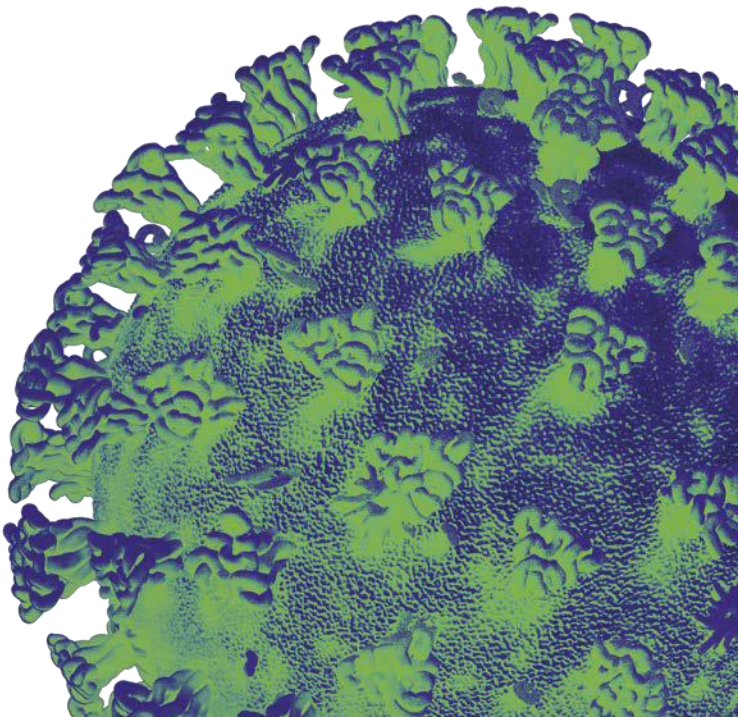




Health inequalities in COVID-19 deaths and hospital admissions in Wales, from March 2020 to July 2022

Summary

- This report looks at inequalities in COVID-19 deaths and hospitalisations over time and how they have changed since the vaccination programme. This includes analysing absolute inequalities using the slope index of inequality and relative inequalities using the relative index of inequality, whilst also calculating the number of Years of Life Lost (YLL) due to COVID-19 as an overall figure and per 1,000 of the Welsh population.
- The overall slope index of inequality (SII) is 215, meaning the gradient of mortality is 215 per 100,000 higher in the most deprived WIMD quintile compared with least deprived WIMD quintile. This shows there has been an inequality gap in relation to COVID-19 deaths between the most and least deprived.
- The overall relative index of inequality (RII) is 1.95 meaning that the most deprived WIMD quintile has mortality 95% above the least deprived.
- The two most deprived quintiles have very similar covid mortality rates to each other but are higher than the least deprived quintiles.
- Since the vaccine roll out, absolute inequalities have diminished but relative inequalities remain.
- This means that since the vaccination programme began, the mortality rate remains higher in the most deprived group compared to the least deprived group (RII), whereas the inequality gap across the whole population between the most and the least disadvantaged has narrowed (SII).
- Absolute inequalities were greater for non-COVID deaths compared to COVID-19 deaths over the course of the pandemic, however, the opposite was true for relative inequalities.
- The average assumed age (based on the median point of the age band) of COVID-19 deaths in Wales was 79.4 years old; this was 80.9 years old for females and 78.3 years old for males.
- The estimated Years of Life Lost (YLL) due to COVID-19 per 1,000 of the population between March 2020 and July 2022 was 28.9.
- Overall, we have estimated that there were 90,645 Years of Life Lost (YLL) due to COVID-19 between March 2020 and July 2022 in Wales.
- We estimate the Years of Life Lost (YLL) per 1,000 of the Welsh population is highest for the most deprived WIMD quintile and the lowest for the least deprived WIMD quintile.
- To put this in context, Williams et al (2022) estimate amongst 20 countries (including USA, France, Italy, Spain and Portugal), that England and Wales had the highest YLL per 1,000 between January 2020 and August 2021.

- Similarly to mortality rates, the most deprived WIMD quintiles in Wales had a higher hospital admission rate compared to the least deprived WIMD quintiles. However, this difference did narrow after the vaccination programme had started.
- During the first and second wave, absolute and relative inequalities for hospitalisations were high. Since the start of the vaccination programme, relative inequalities remain high but absolute inequalities are lower.

Introduction

This paper presents information on the trends of deaths and hospital admissions over the course of the pandemic with data from 1st March 2020 to 31st July 2022 analysed. The first COVID-19 case in Wales was confirmed on 28 February 2020 and the first death occurring on 15th March 2020.

There has been previous analysis suggesting there are health inequalities in relation to COVID-19 deaths in Wales[1] with people from more deprived backgrounds disproportionally affected. This paper aims to explore that assumption looking at the slope index of inequality, relative index of inequality, deaths by Welsh Index of Multiple Deprivation (WIMD) quintile and the number of Years of Life Lost (YLL) due to COVID-19. A glossary of terms is included at the end of this report outlining the definitions of these terms.

The data in this paper covers the period before and after the start of the COVID-19 vaccination programme in Wales and looks at the differences in trends to broadly assess the impact that the vaccination programme may have had on COVID-19 death inequalities.

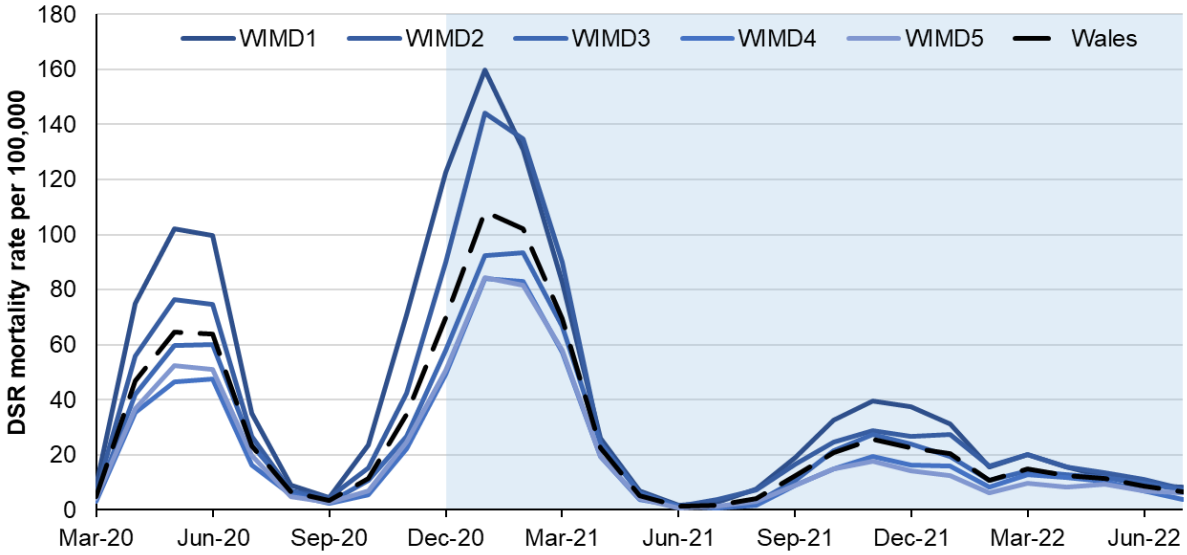
Further details on the methodology and data used in the analysis can be found in the appendix.

[1] https://pubmed.ncbi.nlm.nih.gov/35759952/

Analysis and findings

1. Mortality

Chart 1: COVID-19 mortality rates by WIMD quintile by month (Three-month rolling total), March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

The Welsh Index of Multiple Deprivation (WIMD) is the Welsh Government's official measure of relative deprivation for small areas in Wales. It identifies areas with the highest concentrations of several different types of deprivation. WIMD ranks all small areas in Wales from 1 (most deprived) to 1,909 (least deprived). It is a National Statistic produced by statisticians at the Welsh Government.

These small areas are then combined into five quintiles of equal numbers. Therefore, the 20% of the most deprived areas in Wales are included in WIMD1 and the 20% of the least deprived areas in Wales are included in WIMD5. Further information on the methodology is provided in the Appendix of this paper.

Chart 1 presents COVID-19 mortality rates by WIMD quintile from March 2020 to July 2022 using a three-month rolling total. The blue shaded area represents the start of the COVID-19 vaccination programme in December 2020.

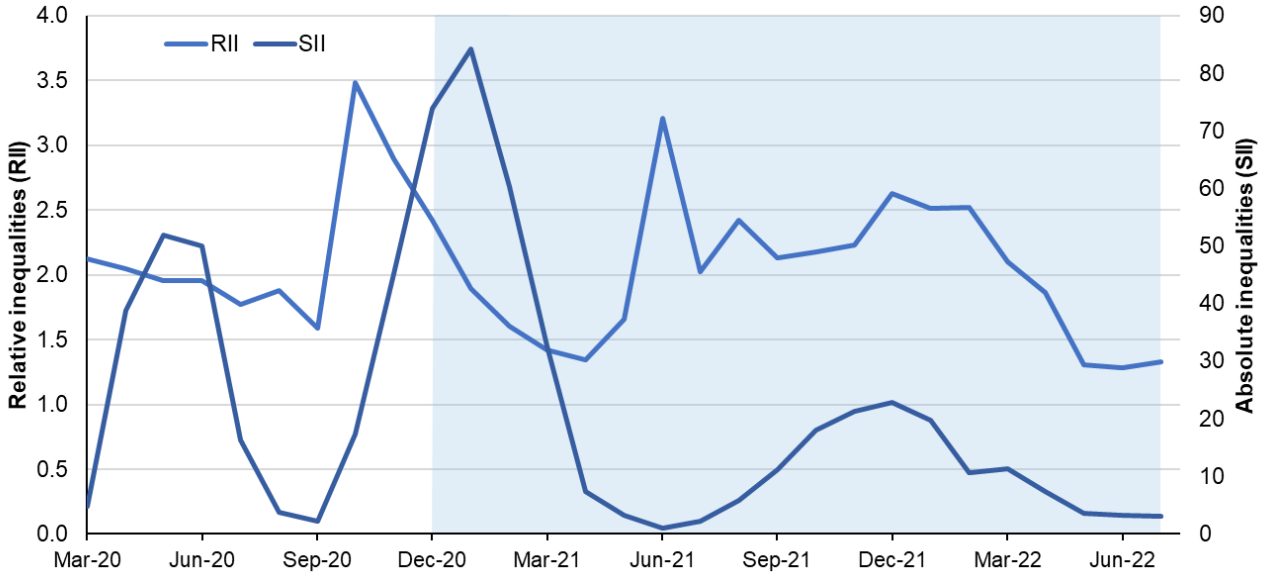
The three-monthly rolling mortality rate peaked in May 2020 (March 2020 to May 2020) for the first wave and then January 2021 (November 2020 to January 2021) for the second wave. It is clear to see the COVID mortality inequalities in both the first and second waves, with the two most deprived quintiles (WIMD1 and WIMD2) having a larger peak than the Wales total and the remaining three WIMD quintiles.

During the second wave, as time progresses the difference in mortality rate between the least deprived and most deprived widens until the peak. Mortality in the most deprived quintile peaks more steeply, whereas in the other quintiles it plateaus more from January to March 2021, which may indicate infections happening more quickly in the most deprived areas then spreading into less deprived areas. During the third wave towards the end of 2021, there remains a difference between mortality rates but this is smaller than the two

previous waves and coincides with a large number of the population having had at least one dose of the vaccine.

Since the vaccination programme it is possible to see that the narrowing of mortality inequalities in the third wave, where the second most deprived quintile (WIMD2) follows a similar trend to the Wales total. The most deprived still have a higher mortality rate but the difference between this quintile and others is smaller. The peak in the third wave for all WIMD quintiles is smaller and flatter compared to the previous two waves.

Chart 2: Absolute and relative COVID-19 mortality inequalities (Three-month rolling total), March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

Chart 2 presents the absolute and relative COVID-19 mortality inequalities from March 2020 to July 2022 using a three-month rolling total. The blue shaded area represents the start of the COVID-19 vaccination programme in December 2020.

Absolute inequalities (SII) is a measure of the difference in life expectancy between the most and least deprived sections of the local population and is known as the inequality gap across the whole population between the most and the least disadvantaged.

Using linear regression, we have calculated the absolute inequalities (SII) for the COVID-19 death rate between March 2020 and July 2022 was 215, which means that the difference between the most and the least disadvantaged groups is 215 deaths per 100,000 population. This is statistically significant at the 5% level of significance.

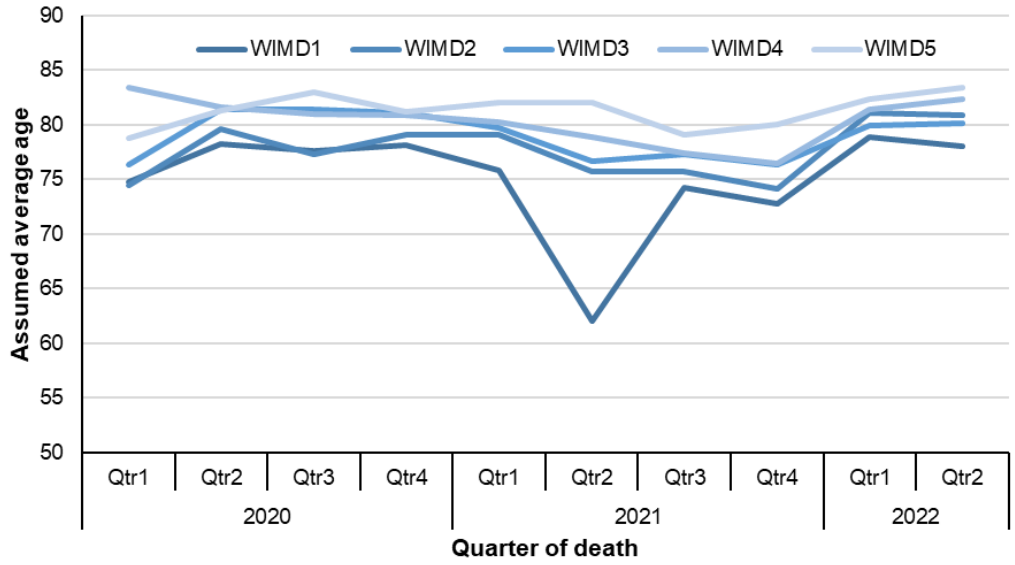
Relative inequalities (RII) is a measure of the difference in mortality rate between the most deprived and least deprived sections of the local population. We have calculated the RII to be 1.9 between March 2020 and July 2022. This means that the mortality rate is 90% higher in the most deprived quintile relative to the least deprived quintile in the population.

More information on the methodology can be found in the Appendix.

During the first and second wave, absolute and relative inequalities were high. Since the start of the vaccination programme relative inequalities (RII) remain high but absolute inequalities (SII) are much lower. This means that since the vaccination programme began,

the mortality rate remains high in the most deprived group compared to the least deprived group in relative terms (RII), whereas the absolute inequality gap across the whole population between the most and the least disadvantaged has narrowed (SII).

Chart 3: Estimated average age of COVID-19 deaths by WIMD quintile, Quarter 1 2020 to Q2 2022



Source: Analysis of ONS mortality data supplied by DHCW

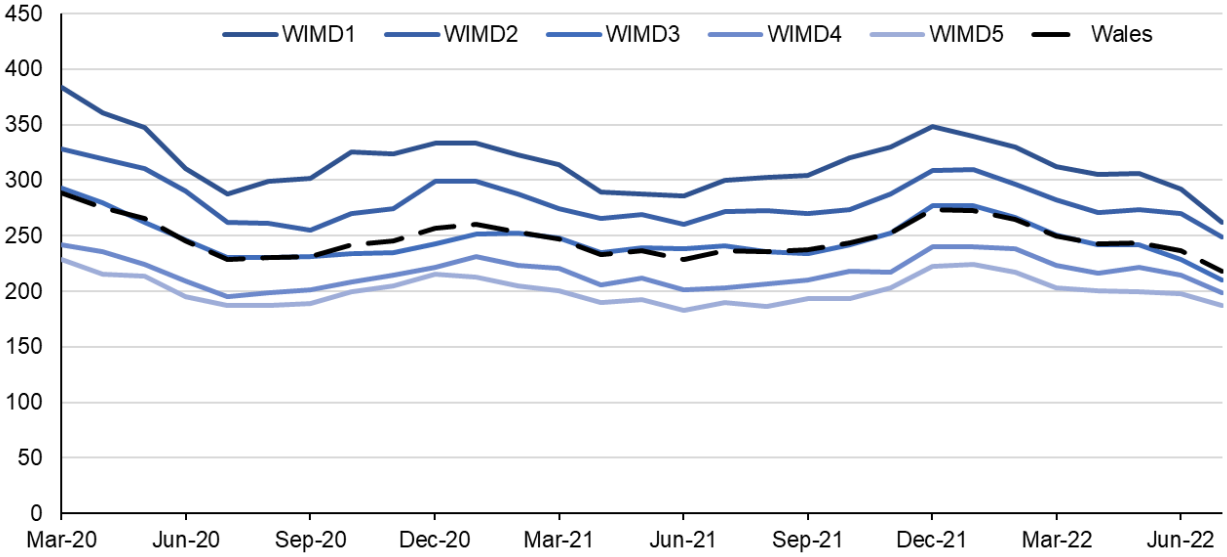
Chart 3 presents the estimated average age of COVID-19 deaths between Quarter 1 2020 and Quarter 2 2022. Assumed age is calculated as the median age from the age group an individual has been assigned to, e.g. an individual in age group 50-54 years of age has an assumed age of 52 years old.

The estimated average age of COVID-19 deaths is lower in the most deprived quintile compared to the least deprived and other quintiles.

The pronounced drop in assumed average age for the WIMD1 quintile in quarter 2 2021 is likely due to the relative low number of deaths during this quarter meaning that the data is more noisy. For context, there were 12 deaths for the WIMD1 quintile during quarter 2 2021 compared to over 100 deaths in quarter 3 2021.

How do COVID-19 mortality rates and inequalities compare with non-COVID-19?

Chart 4: non COVID-19 mortality rates by WIMD quintile by month (Three-month rolling total), March 2020 to July 2022

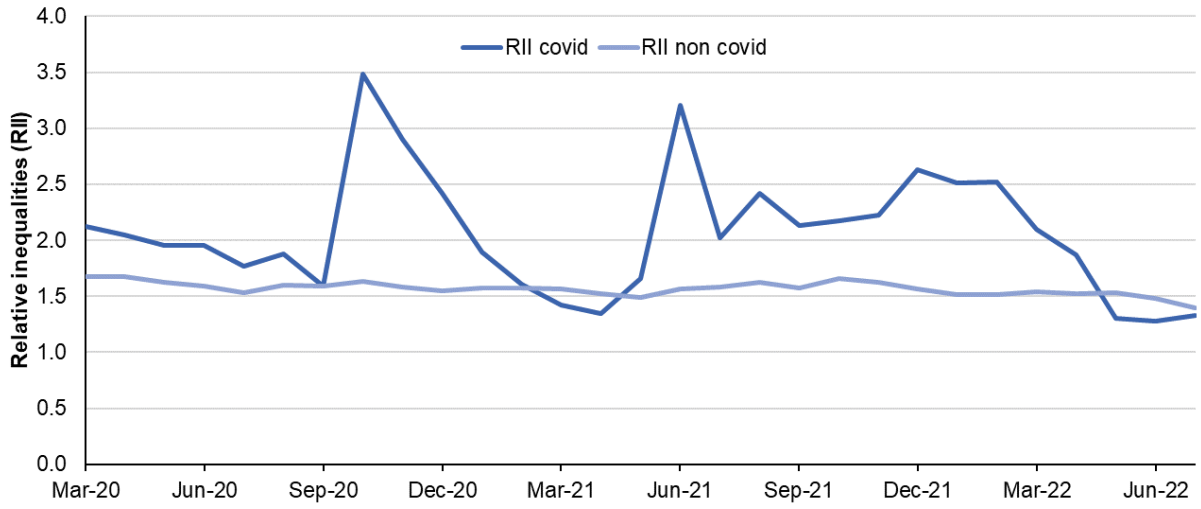


Source: Analysis of ONS mortality data supplied by DHCW

Comparing over the course of the pandemic and the same time period as COVID-19 deaths, Chart 4 shows there is a clear social gradient with non-COVID-19 deaths. The mortality rates for the most deprived (WIMD1) have been consistently higher than the rate for the least deprived (WIMD5).

When comparing absolute and relative inequalities between COVID-19 and non-COVID-19 deaths we see a slightly different picture.

Chart 5: Relative COVID-19 and non-COVID-19 mortality inequalities (Three-month rolling total), March 2020 to July 2022

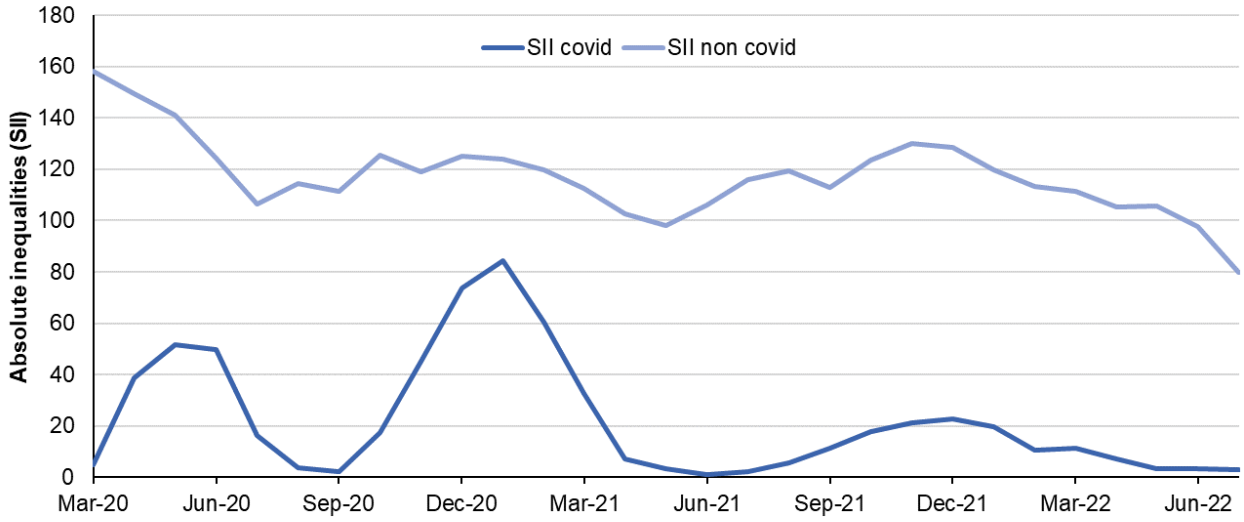


Source: Analysis of ONS mortality data supplied by DHCW

Chart 5 shows relative inequalities over the course of the pandemic were greater for COVID-19 deaths than non-COVID-19 deaths. This means that the difference in mortality rate between the most deprived and least deprived was greater for COVID-19 deaths compared to non-COVID-19 deaths.

During the time period, relative inequalities of non-COVID-19 deaths were broadly steady compared to COVID-19 deaths.

Chart 6: Absolute COVID-19 and non-COVID-19 mortality inequalities (Three-month rolling total), March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

This differs for absolute inequalities. Chart 6 shows that absolute inequalities were greater for non-COVID-19 deaths over the course of the pandemic than COVID-19 deaths. This means the inequality gap across the whole population between the most and the least disadvantaged was higher for non-COVID-19 deaths compared to COVID-19 deaths.

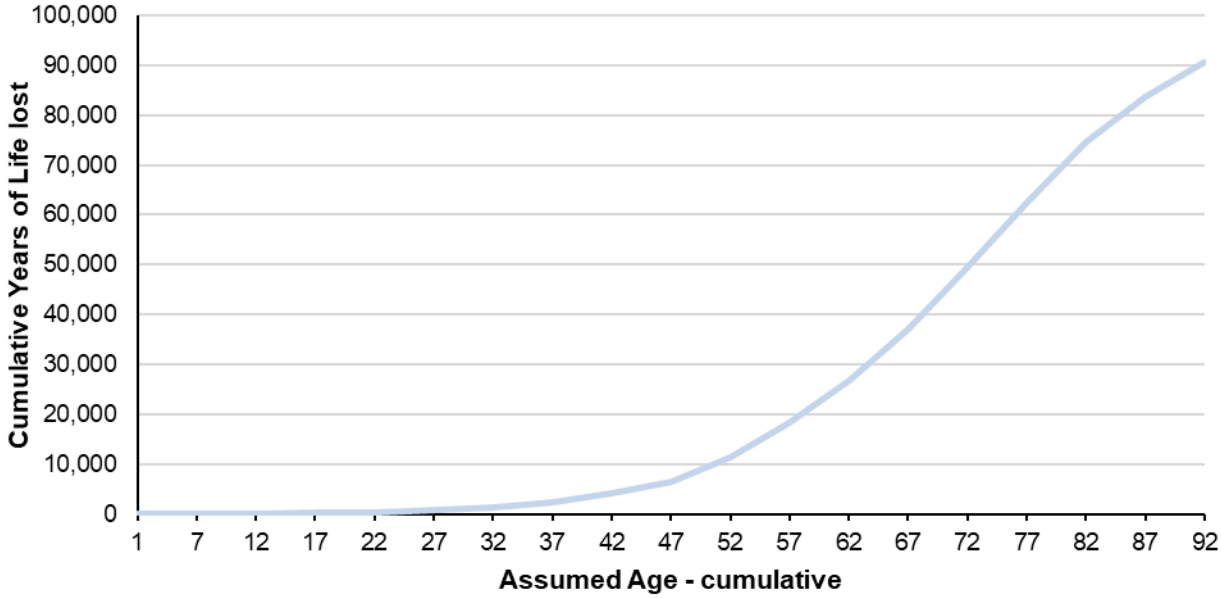
This may be expected since the absolute volume of non-COVID-19 deaths is higher – COVID-19 as the underlying cause of death made up 6.9% of deaths in the time period we looked at.

Chart 6 also shows the peaks in absolute inequalities during the first and second wave of the pandemic, where the data suggests absolute inequalities were greater during the second wave. However, The third wave has a smaller peak than the first two waves and also a move gradual incline, coinciding with a large proportion of the population having received doses of the vaccine.

Years of Life Lost

Years of Life Lost (YLL) is a measure of premature mortality that takes into account both the frequency of deaths and the age at which it occurs. YLLs are calculated from the number of deaths multiplied by a global standard life expectancy at the age at which death occur

Chart 7: Total age-cumulative years of Life Lost (YLL) due to COVID-19 in Wales, March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

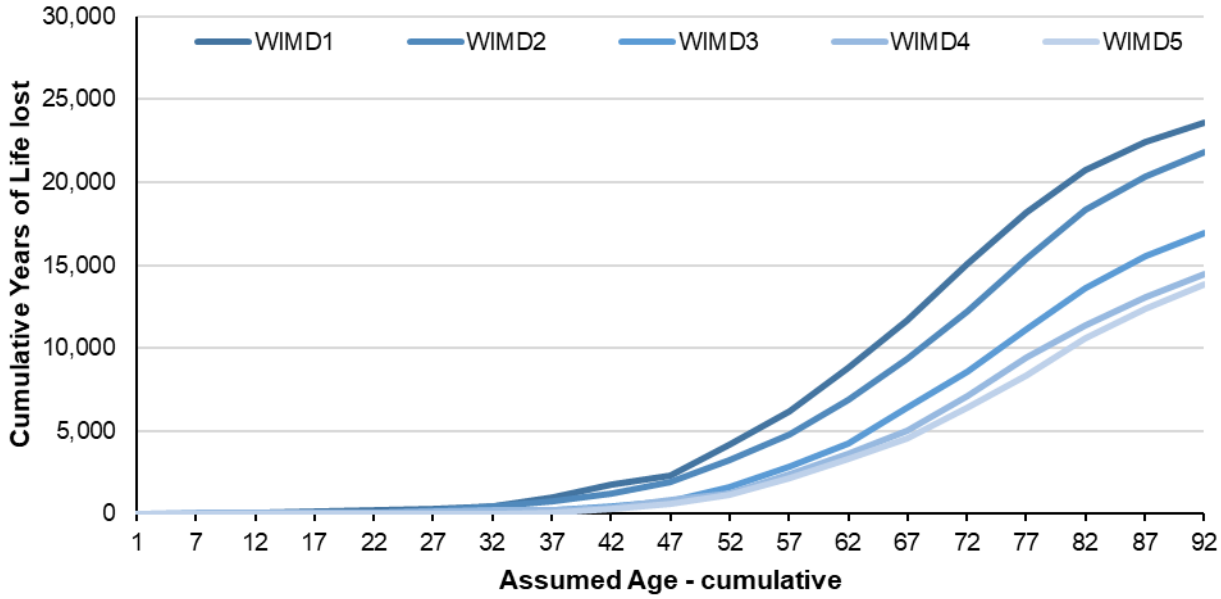
Chart 7 shows the cumulative years of life lost due to COVID-19 between March 2020 and July 2022 by assumed age.

This shows a different pattern to mortality, as deaths in younger ages produce more YLL per death. Accounting for COVID-19 deaths during this period we have estimated 90,645 years of life lost due to COVID-19. UK Treasury Green Book (2022) values Statistical Life Years (SLYs) at £60,000 per SLY[2] which would value these YLL for Wales at £5.439billion. This is only the value of YLL from acute covid death and does not factor in potential shorter life expectancy through other sequelae of COVID-19, and does not factor in the value of morbidity-related losses due to the virus.

As may be expected, the gradient of the curve becomes steeper as the assumed age increases. Around 53% of YLL due to COVID-19 were between 65 years old and 84 years old, with these age groups accounting for 48% of COVID-19 deaths.

[2] The Green Book (2022) - GOV.UK (www.gov.uk)

Chart 8: Age-cumulative years of Life Lost (YLL) due to COVID-19 by WIMD quintile, March 2020 to July 2022

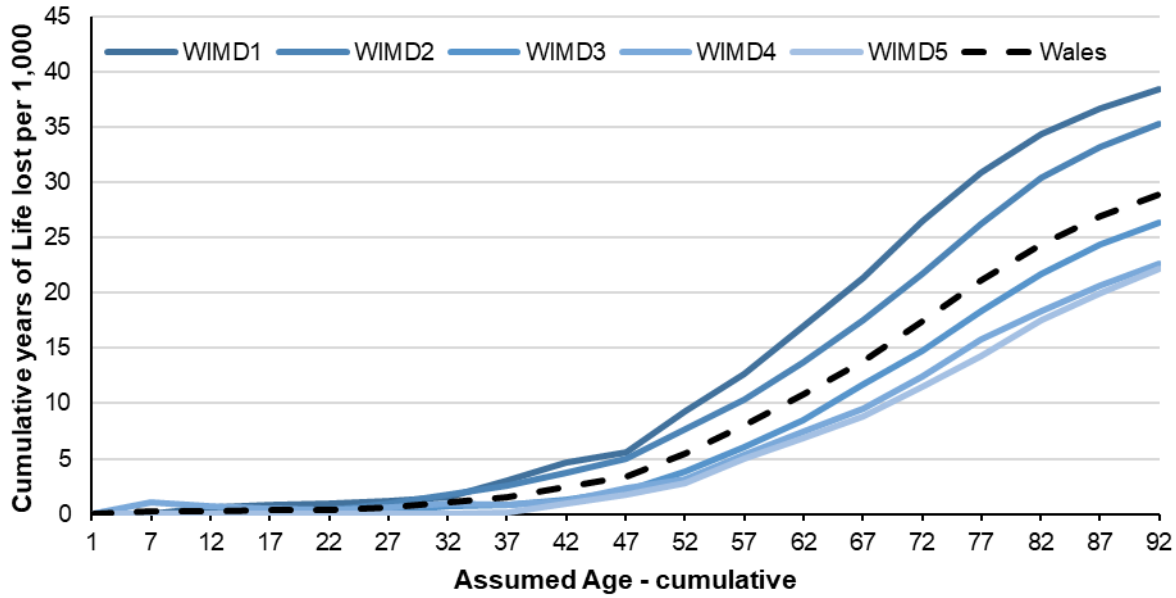


Source: Analysis of ONS mortality data supplied by DHCW

Chart 8 presents the cumulative (through age groups) number of YLL due to COVID-19 for each WIMD quintile. This shows that the number of YLL was greater in the two most deprived groups (WIMD1 and WIMD2), which represents 40% of the most deprived compared to the least deprived in Wales. However, it is important to note that 46% of COVID-19 deaths during the time period were individuals in the two most deprived WIMD quintiles.

To add some perspective, we have looked at Years of Life Lost (YLL) per population for Wales as a whole and for each WIMD quintile. It is important to note that the populations are broadly similar for each WIMD quintile, therefore the trend lines are similar between Chart 8 and Chart 9.

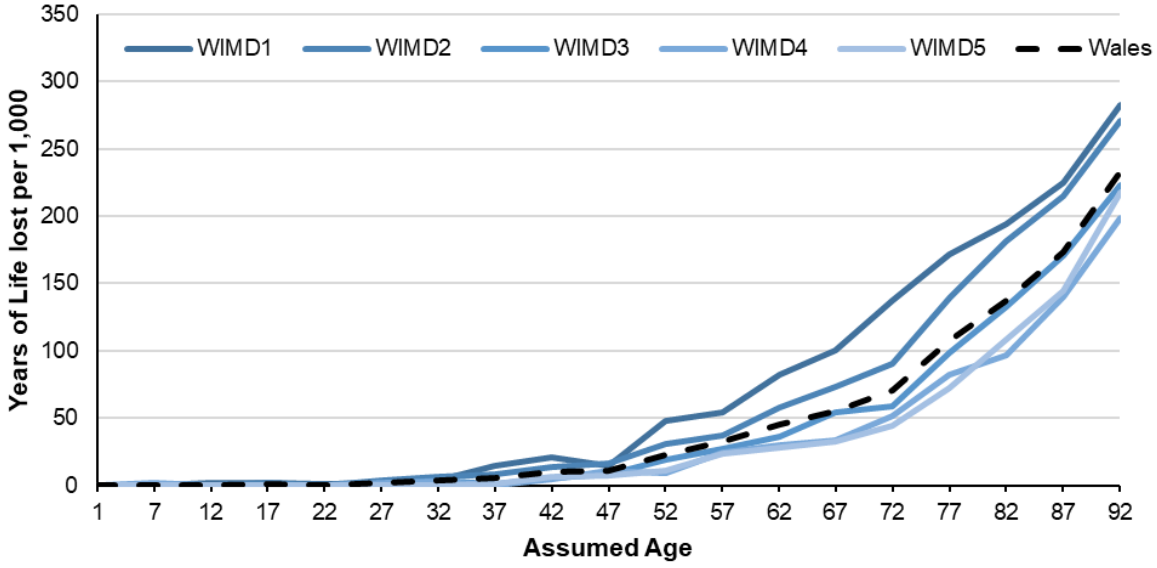
Chart 9: Age-cumulative Years of Life Lost (YLL) due to COVID-19 per 1,000 population (in each WIMD quintile or Wales), March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

Between March 2020 and July 2022, we have estimated Years of Life Lost per 1,000 due to COVID-19 as 28.9. Chart 9 presents the cumulative YLL due to COVID-19 per 1,000 between March 2020 and July 2022, showing the variation between the different WIMD quintiles. We have estimated that YLL per 1,000 due to COVID-19 was 38.4 for the most deprived quintile compared to 22.2 for the least deprived quintile.

Chart 10: Years of Life Lost (YLL) due to COVID-19, per 1000 people in each age group, March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

Chart 9 presents the cumulative YLL per 1,000, whereas Chart 10 presents the YLL per 1,000 for each assumed age category. This enables us to compare the YLL rates for each assumed age group and also between WIMD quintiles.

To give some perspective of the differences between WIMD quintiles we have compared the rate of YLL between the most and least deprived quintiles:

- For someone with an assumed age of 52 years old (50 to 54 years old group) in the most deprived quintile, their cumulative rate of YLL (47.47) is most similar to someone aged 72 years old in the least deprived quintile (44.7).
- For someone with an assumed age of 62 years old (60 to 64 years old group) in the most deprived quintile, their cumulative rate of YLL (82.5) is most similar to someone aged 77 years old in the least deprived quintile (72.0).

We have estimated the Years of Life Lost per 1,000 due to COVID-19 as 28.9 between March 2020 and July 2022. This is a similar figure to a study by Williams et al (2022)[3] for England and Wales (26.5), albeit with a different source of data and shorter time period (data accessed on 4 August 2021) used by Williams et al (2022).

However, comparisons of our estimate to other countries in different studies should be made with an element of caution due to the difference in time periods used in this analysis and that used in Williams et al (2022). It is more appropriate to compare only the figures in the Williams et al (2022) paper.

In Williams et al (2022), they estimated YLL due to COVID-19 per 1,000 of the population was 26.5 for England and Wales, which was the lowest ranked area/country of the twenty countries included in the study, i.e. the highest YLL per 1,000 value. The values for similar neighbouring European countries included in the study were:

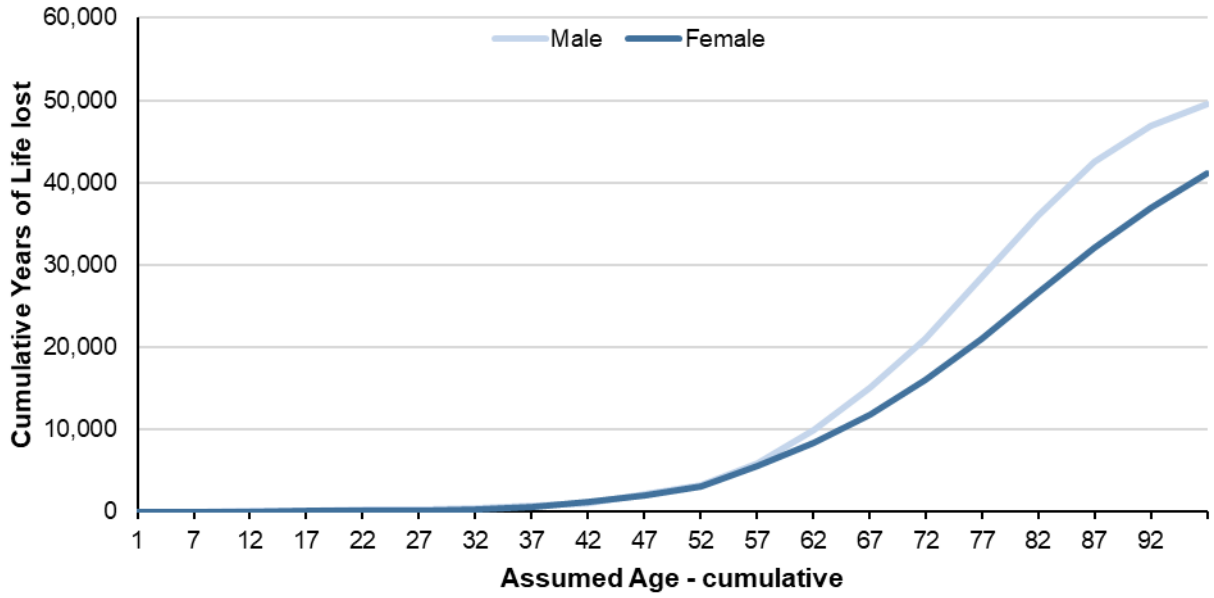
- Scotland, 20.0
- Italy, 23.3
- Spain, 20.4
- Portugal, 17.8
- France, 14.7

Other countries of interest include USA with a value of 26.0 and South Korea of 0.5, which is perhaps a result of the different policies amongst countries.

A future analysis we may want to consider if possible would be to obtain data to produce a country comparison similar to Williams et al (2022) with data to include further waves of the pandemic, e.g. the Omicron variant.

[3] Williams, G., Spencer, A., Tracey, F., Gittins, M. and Arpana, V., 2022. Years of life lost to COVID-19 in 20 countries. Journal of Global Health, 12. Years of life lost to COVID-19 in 20 countries — JOGH

Chart 11: Age-cumulative Years of Life Lost (YLL) due to COVID-19 by sex and age, March 2020 to July 2022

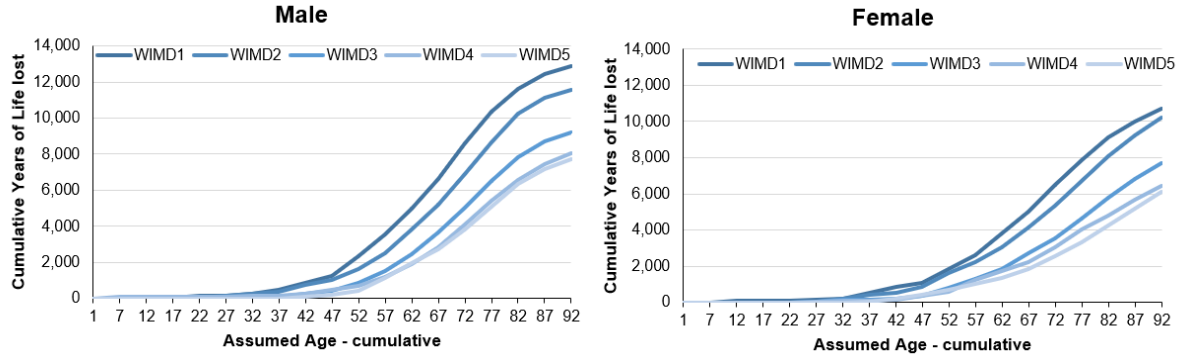


Source: Analysis of ONS mortality data supplied by DHCW

Between March 2020 and July 2022, we have estimated 90,645 years of life lost due to COVID-19. There is a difference between the cumulative YLL due to COVID-19 when splitting out the data by sex with the cumulative YLL higher for males than females. However, prior to the assumed age of 62 years old, the trend line between males and females was broadly similar before diverging.

This could be due to the difference in the average of age of COVID-19 deaths between males and females, with the average for males being 78.3 years old and 80.9 years old for females.

Chart 12: Age-cumulative Years of Life Lost (YLL) due to COVID-19 by WIMD quintile and spilt by sex, March 2020 to July 2022



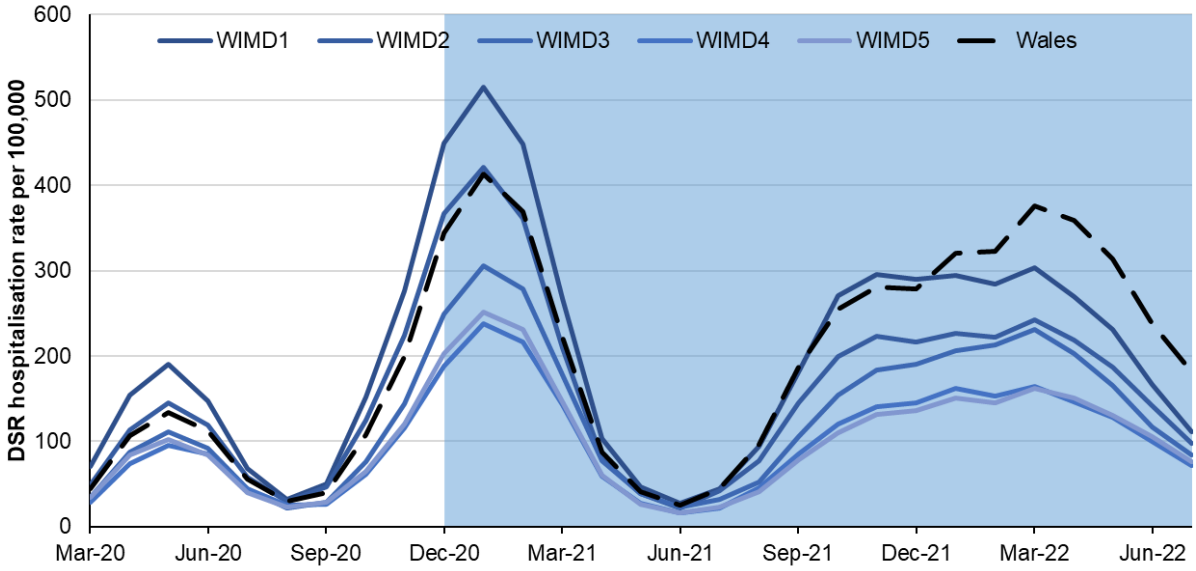
Source: Analysis of ONS mortality data supplied by DHCW

Chart 12 presents the cumulative YLL due to COVID-19 by WIMD quintile and shows the difference between males and females. For both sexes the most deprived quintile (WIMD1) has the highest number of YLL and the least deprived quintile has the lowest number of YLL.

For males the difference between the most deprived and second most deprived quintile was higher compared to females. For females, the difference in cumulative YLL for the least deprived (WIMD5) and the second least deprived (WIMD4) is greater than the difference for males. For males, health inequalities are more pronounced at an earlier age, than in females.

2. Hospitalisations

Chart 13: COVID-19 hospitalisation rates by WIMD quintile by month (Three-month rolling total), March 2020 to July 2022



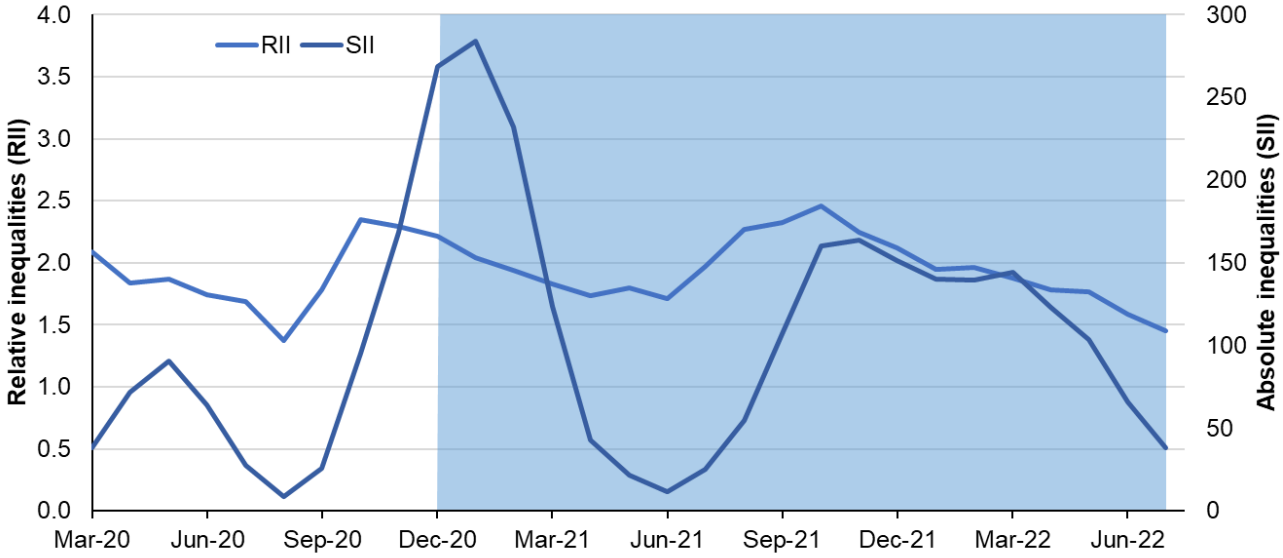
Source: PEDW hospitalisation data supplied by DHCW

Chart 13 presents COVID-19 hospitalisation (hospital admissions) rates by WIMD quintile from March 2020 to July 2022 using a three-month rolling total. The blue shaded area represents the time since the COVID-19 vaccination programme began in December 2020.

The three-monthly rolling hospitalisation rate peaked in May 2020 (March 2020 to May 2020) for the first wave and then January 2021 (November 2020 to January 2021) for the second wave. It is clear to see the COVID-19 hospitalisation inequalities in both the first and second waves, with the most deprived quintiles (WIMD1) having a larger peak than the Wales total and also the remaining quintiles. During the second wave, as time progresses the difference in hospitalisation rate between the least deprived and most deprived widens until the peak.

Since the vaccination programme it is possible to see that the narrowing of hospitalisation inequalities in the third wave. The most deprived still have a higher hospitalisation rate but the difference between this quintile and others is smaller. The first and second most deprived quintiles have fallen below the level for the whole of Wales during the third wave. The peak in the third wave is flatter compared to the first and second waves but smaller than the highest point of the second wave.

Chart 14: Absolute and relative COVID-19 hospitalisation inequalities (Three-month rolling total), March 2020 to July 2022



Source: PEDW data supplied by DHCW

Chart 14 presents the absolute and relative COVID-19 hospitalisation inequalities from March 2020 to July 2022 using a three-month rolling total. The blue shaded area represents the start of the COVID-19 vaccination programme in December 2020.

During the first and second wave, absolute and relative inequalities were high. Since the start of the vaccination programme relative inequalities remain high but absolute inequalities are lower compared to the second wave and have decreased since March 2022.

Discussion/Conclusion

This work has shown that since the vaccination programme, absolute inequalities in mortality have fallen but relative inequalities have persisted. For admissions both absolute and relative inequalities are still present. This suggests that policy makers need to be clear about what the objective is around reducing inequalities. Clearly, as referenced above, the impact of COVID-19 has had a disproportionate impact on the most deprived, underlining the more general and well established evidence that health outcomes are closely correlated with deprivation. For policy makers, this is another reminder that when developing any policies, it is important to understand their relative impacts on different parts of society. Also, it reinforces the more general point about the role of government policy and programmes in addressing structural inequalities in society and how the full range of activity can be brought together in a way that is consistent, mutually reinforcing and focused on reducing the inequality gap.

The Joint Committee on Vaccination and Immunisation (JCVI) have recently announced that for Winter 2022, boosters will be given to people aged 50 and over, as well as people with long term conditions. The present paper has shown that there are deaths in under 50s from COVID-19, and these deaths are more likely in deprived populations. The persistent nature of health inequalities suggests that efforts need to continue to engage with people from deprived areas to keep vaccination rates high. It also suggests that where vaccination policy is based on prevalence of long term conditions, the NHS in Wales needs to ensure that long

term conditions are diagnosed and recorded in people in deprived areas; as late diagnosis might mean that people who should be eligible for covid and other vaccines are not receiving them. This might be illuminated by comparing the equity gradient for incidence (new diagnosis) of long term conditions with the equity gradient for vaccine uptake. If people find it harder to access primary care in deprived areas as well as possibly having lower levels of health literacy and health seeking behaviour, then this can exacerbate these issues.

There are three main pathways linking socioeconomic status and health: materialist, psychosocial, and behavioural/cultural. The materialist explanation focuses on income and on what income enables – access to goods and services and preventing exposure to material risk factors like poor housing, inadequate diet, risky workplaces. Psychosocial explanations focus on how social inequality makes people feel in terms of social status, social support, demands and control – and the biological effects of these feelings on health, for instance through stress. The behavioural explanation suggests that exposure to external risks promotes unhealthy behaviours which may also be more culturally acceptable among lower socioeconomic groups. Understanding more about the contribution of these different pathways enables us to tailor the policy response, and it is likely that they are different for different health outcomes, for instance inequalities in smoking may be more related to behaviour and culture, whereas anxiety may be more related to psychosocial stress.

Many people in deprived areas have multiple, intersecting risk factors which combine to increase the risk of poor COVID-19 outcomes. Further work could look at socioeconomic inequalities and how much of them are mediated through wider determinants like education, income, overcrowded housing, living in a care home, occupation; clinical risk factors like smoking, diet, BMI, and blood pressure, and diseases like cardiovascular disease (CVD), type 2 diabetes, and chronic obstructive pulmonary disease (COPD); to further understand the drivers of health inequalities in Wales. This paper has compared covid with non-covid causes and found that absolute inequalities were greater for other causes combined but relative inequalities were greater for COVID-19. Building on this analysis, the gradient in mortality and admissions could be compared with those for other specific diseases to see if it is wider, for instance COPD which is mainly related to smoking which has a strong socioeconomic gradient.

There has been a previous Welsh Government Technical Advisory Cell (TAC) report on health inequalities[4] which was produced early in the pandemic and before the vaccination programme began, and there is the WHESRi (Welsh Health Equity Status Report initiative) paper[5] on COVID-19 and health inequalities; both of which make recommendations around policies to reduce health inequalities.

[4] Technical Advisory Cell: coronavirus (COVID-19) and health inequalities | GOV.WALES

[5] https://phw.nhs.wales/news/placing-health-equity-at-the-heart-of-coronavirus-recovery-for-building-a-sustainable-future-for-wales/placing-health-equity-at-the-heart-of-the-covid-19-sustainable-response-and-recovery-building-prosperous-lives-for-all-in-wales/

Appendix

Methods

The mortality and hospitalisation data in this analysis was provided by Digital Health and Care Wales. The data provided is for deaths in Wales and was from 1st March 2020 to 31st July 2022 with the first COVID-19 death occurring on 15th March 2020. We have used the Office for National Statistics (ONS) 'covid underlying cause' as our definition of covid deaths in this analysis. In ONS' definition, when they say a death is 'due to' COVID-19, they mean that COVID-19 was the underlying cause of death, because it was either the only health condition mentioned on the death certificate, or it was the one that started the train of events leading to death. When ONS say that a death 'involved' COVID-19, they mean that COVID-19 was mentioned anywhere on the death certificate, possibly along with other health conditions, not necessarily as the underlying cause of death. For the purpose of this analysis we have used deaths 'due to' COVID-19 as our definition of COVID-19 deaths[6].

We calculated age standardised mortality rates using ONS methods with deaths in 5-year age bands, from 0-4 up to 90+, using the 2013 European Standard Population (ESP). We used mid-2018 estimates of populations for Wales by LSOA which were aggregated up to WIMD 2019 quintile. We did not adjust the populations used for the fact that the mortality data went across different time periods, e.g. stretched across multiple years, but this would not affect the trend in inequalities.

The Welsh Index of Multiple Deprivation (WIMD) is the Welsh Government's official measure of relative deprivation for small areas in Wales. It identifies areas with the highest concentrations of several different types of deprivation. WIMD ranks all small areas in Wales from 1 (most deprived) to 1,909 (least deprived). It is a National Statistic produced by statisticians at the Welsh Government.

The concept of an Index of Multiple Deprivation as we now know it was originally developed by the Social Disadvantage Research Centre of Oxford University, who produced the first WIMD in 2000.

Subsequent updates were made in 2005, 2008, 2011 and 2014.

Table 1 presents the different WIMD quintiles used in this analysis and paper.

Table 1: WIMD deprivation quintile groups used

Quintile	Quintile Group
WIMD1	20% most deprived
WIMD2	20-40% most deprived
WIMD3	40-60% most deprived
WIMD4	60-80% most deprived
WIMD5	20% least deprived

Source: Welsh Index of Multiple Deprivation, Welsh Government

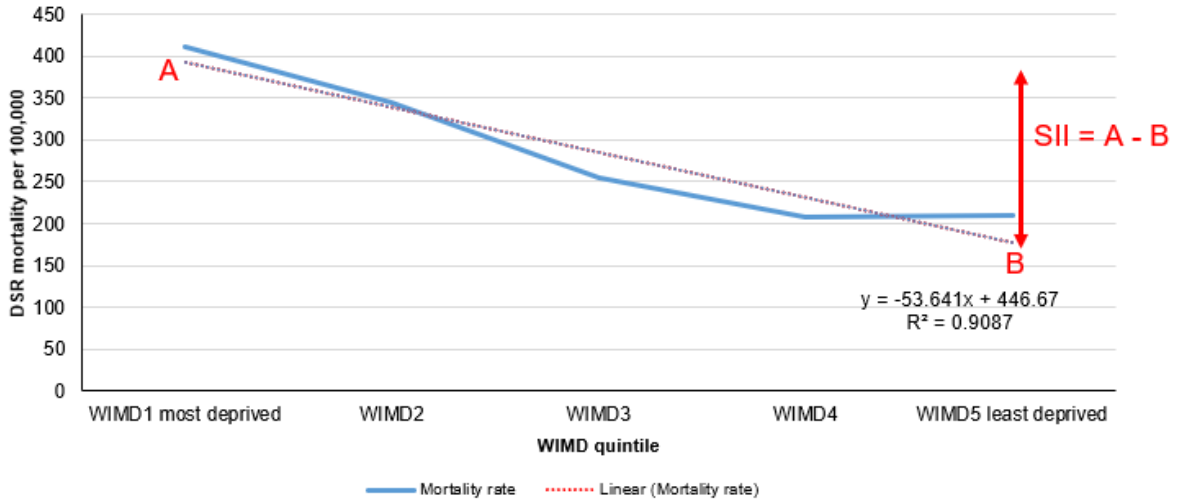
Further guidance and information on WIMD has been published on the Welsh Index of Multiple Deprivation webpage of the statistics and research area of the Welsh Government website.

[6] Definition of "deaths involving COVID-19" - Office for National Statistics (ons.gov.uk)

There are different definitions and methods for the slope index of inequality (SII) to measure absolute inequalities and the relative index of inequality (RII) to measure relative inequalities. For SII we used linear regression which fit the data reasonably well, with an overall R^2 of 0.89 for covid mortality rates by WIMD quintiles.

Here we use RII = rate for most deprived WIMD quintile / rate for least deprived quintile.

Chart A1: Slope index of COVID-19 death inequalities, March 2020 to July 2022

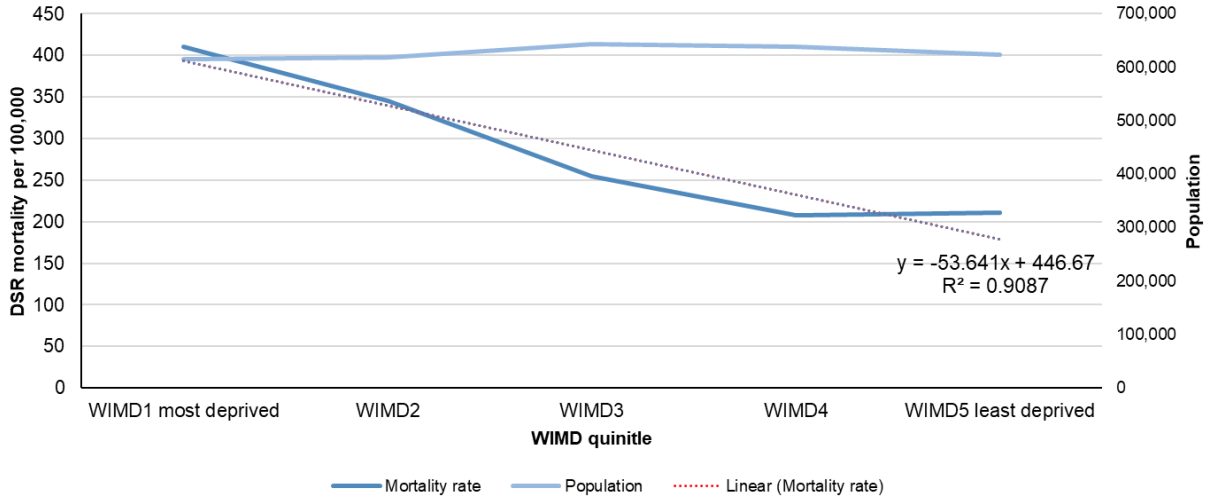


Source: Analysis of ONS mortality data supplied by DHCW

Chart A1 presents the slope index of inequalities (SII) for COVID-19 deaths in Wales. The highest directly standardised mortality rate (DSR) per 100,000 of the population was seen in the most deprived WIMD quintile (WIMD1) at 410 COVID-19 deaths per 100,000 between March 2019 and July 2022. This is compared to 211 COVID-19 deaths per 100,000 in the least deprived quintile (WIMD5).

The mortality rate is lower across the other WIMD quintiles with a general downward trend from the most to least deprived quintiles, with the exception the WIMD5 quintile being slightly higher compared to WIMD4. The SII was calculated using liner regression and fits the data reasonably well with a R squared value of 0.91.

Chart A2: Slope index of COVID-19 death inequalities with population mean, March 2020 to July 2022



Source: Analysis of ONS mortality data supplied by DHCW

For trends in mortality, RII and SII we used three months rolling data (e.g. January-March 2020, February-April 2020, etc.). This is due to the small numbers involved in the analysis following advice from Public Health Wales colleagues.

To calculate the Years of Life Lost (YLL), we used the number of COVID-19 deaths from data supplied by Digital Health and Care Wales (DCHW) and calculated remaining life expectancy from the National life tables for Wales published by ONS[7]. The mortality data supplied by DCHW does not include the exact age of the individual but does include an age group. Therefore, the median age point for each age group was used for the Remaining Life Expectancy (RLE), with the exception of less than 1 years, 1-4 years and 90+ years groups. Table 2 presents the age groups and assumed ages used in the YLL analysis.

Table 2: Age group and assumed age from DCHW mortality data

Age Group	Assumed Age
Less than 1 years	0
1-4 years	1
5-9 years	7
10-14 years	12
15-19 years	17
20-24 years	22
25-29 years	27
30-34 years	32
35-39 years	37
40-44 years	42
45-49 years	47
50-54 years	52
55-59 years	57
60-64 years	62
65-69 years	67

[7] National life tables: Wales - Office for National Statistics (ons.gov.uk)

70-74 years	72
75-79 years	77
80-84 years	82
85-89 years	87
90+ years	92

Source: Analysis of ONS mortality data supplied by DHCW

Similar to Williams et al (2022)[8], we have calculated the number of Years of Life Lost (YLL) using the formula YLL = N x L. N is the number of deaths with an underlying cause of COVID-19 as per the ONS definition within each age and sex group and L as the life expectancy the age of death (Remaining Life Expectancy).

The Remaining Life Expectancy (RLE) was calculated for each age and sex group using life expectancy data published by the ONS in the National Life Tables: Wales[9]. These data are based on the population estimates and deaths by date of registration data for a period of 3 consecutive years. For this analysis, the current set of national life tables for 2018-2020 were used, which is based on the mid-year population estimates for 2018, 2019 and 2020.

Overall YLLs were calculated for the period March 2020 to July 2022 for each WIMD quintile, sex and age category. The data in this analysis has been presented as overall YLL for each WIMD quintile for each assumed age group and also YLL per 1,000 population to take into account population size for each age group.

Data in this analysis has been presented at each assumed age group and also as a cumulative figure at each age group, charts have been labelled accordingly.

[8] Williams, G., Spencer, A., Tracey, F., Gittins, M. and Arpana, V., 2022. Years of life lost to COVID-19 in 20 countries. Journal of Global Health, 12. Years of life lost to COVID-19 in 20 countries — JOGH

[9] National life tables: Wales - Office for National Statistics (ons.gov.uk)

Glossary of terms

Term	Description
Years of Life Lost (YLL)	Years of life lost (YLL) is a measure of premature mortality that takes into account both the frequency of deaths and the age at which it occurs. YLLs are calculated from the number of deaths multiplied by a global standard life expectancy at the age at which death occur. YLLs can be expressed per 100 000 population.
Absolute inequalities (SII)	The Slope Index of Inequality (SII) is a measure of the difference in life expectancy between the most and least deprived sections of the local population and is known as the inequality gap across the whole population between the most and the least disadvantaged. For example, a SII of 127 for the COVID-19 death rate means that the difference between the most and the least disadvantaged groups is 127 deaths per 100,000 population.
Slope index of inequality (SII)	The Slope Index of Inequality (SII) is a measure of the difference in life expectancy between the most and least deprived sections of the local population and is known as the inequality gap across the whole population between the most and the least disadvantaged. For example, a SII of 127 for the COVID-19 death rate means that the difference between the most and the least disadvantaged groups is 127 deaths per 100,000 population.
Relative inequalities (RII)	The linear RII usually ranges between -2 and 2. It can exceed 2 when the relationship is not linear. If the linear RII is multiplied by 0.5 and expressed as a percentage it can be interpreted as follows (using the example of area deprivation) "the most deprived group has a rate xx% above/below the least deprived group". For example, a linear RII of 1.8 means that the rate is around 80% higher in the most deprived group relative to the least deprived group in the population.
Relative index of inequality (RII)	The linear RII usually ranges between -2 and 2. It can exceed 2 when the relationship is not linear. If the linear RII is multiplied by 0.5 and expressed as a percentage it can be interpreted as follows (using the example of area deprivation) "the most deprived group has a rate xx% above/below the least deprived group". For example, a linear RII of 1.8 means that the rate is around 80% higher in the most deprived group relative to the least deprived group in the population.

Statistical Life Years (SLY)	The value of a SLY is derived from the social value of a small change in the probability (the risk) of losing or gaining a year of life expectancy. This value can be of use when appraising options that involve different changes to life expectancy
Welsh Index of Multiple Deprivation (WIMD) quintile	The Welsh Index of Multiple Deprivation (WIMD) is the Welsh Government's official measure of relative deprivation for small areas in Wales