

Widening of inequalities in COVID-19 years of life lost from 2020 to 2021: a Scottish Burden of Disease Study

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ABSTRACT

Background Previous studies have highlighted the large extent of inequality in adverse COVID-19 health outcomes. Our aim was to monitor changes in overall, and inequalities in, COVID-19 years of life lost to premature mortality (YLL) in Scotland from 2020 and 2021.

Methods Cause-specific COVID-19 mortality counts were derived at age group and area deprivation level using Scottish death registrations for 2020 and 2021. YLL was estimated by multiplying mortality counts by age-conditional life expectancy from the Global Burden of Disease 2019 reference life table. Various measures of absolute and relative inequality were estimated for triangulation purposes.

Results There were marked inequalities in COVID-19 YLL by area deprivation in 2020, which were further exacerbated in 2021; confirmed across all measures of absolute and relative inequality. Half (51%) of COVID-19 YLL was attributable to inequalities in area deprivation in 2021, an increase from 41% in 2020.

Conclusion Despite a highly impactful vaccination programme in preventing mortality, COVID-19 continues to represent a substantial area of fatal population health loss for which inequalities have widened. Tackling systemic inequalities with effective interventions is required to mitigate further unjust health loss in the Scottish population from COVID-19 and other causes of ill-health and mortality.

INTRODUCTION

Regular reporting of cases and deaths from COVID-19 has continued into 2022 as the pandemic recently reached 2-year duration. These data have been required to develop the necessary intelligence to inform policy decisions on issues such as: general physical distancing measures; severity of any requirement for localised restrictions; and prioritising and targeting of vaccination efforts.¹ Previous evidence has highlighted the substantial overall impact of COVID-19 on the population health of Scotland, by illustrating that it was a leading cause of disease burden in 2020, second only to heart disease.² Furthermore, the disease burden was not shared equally among areas experiencing different levels of deprivation, with high levels of absolute and relative inequality prevailing.³

The UK embarked on a mass vaccination programme in December 2020. Since then, research studies have evidenced the positive impact of

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Previous studies have highlighted that COVID-19 has a disproportionate impact on health outcomes, with those living in deprived areas suffering the worst outcomes.
- ⇒ A UK-wide vaccination campaign has successfully averted many deaths from COVID-19, however inequalities in vaccination uptake persist through the first, second and subsequent doses.

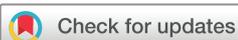
WHAT THIS STUDY ADDS

- ⇒ This study has highlighted that the high level of inequality in COVID-19 mortality was further exacerbated in 2021, with half of fatal years of life lost to COVID-19 being inequality attributable.
- ⇒ The widening of estimates of inequality was driven by two factors: unequal improvements in COVID-19 mortality and a disproportionately higher number of deaths from younger ages in deprived areas.
- ⇒ Despite the success in averting COVID-19 mortality from vaccination, the impact of COVID-19 mortality in 2021 was substantial and comparable with pre-pandemic population health losses from lung cancer or drug use disorders.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE AND/OR POLICY

- ⇒ This study underscores the importance of tackling systemic inequalities with effective interventions to mitigate further unjust health loss in the Scottish population from not only COVID-19, but from other causes of health loss.

vaccination in mitigating severe outcomes from COVID-19 infection in Scotland through reducing the severity of cases and the number of deaths.^{4,5} The vaccination programme has been successful in achieving high population-level uptake in all constituent nations of the UK.⁶ As at the end of 2021, 91% of the 18+ years Scottish population had received the first dose, 88% the second dose and 67% the third dose.⁷ COVID-19 deaths have been lower in 2021 compared with 2020, although during winter in early 2021—when the vaccination programme was in its



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infancy—there was a profound number of COVID-19 deaths during a biphasic second wave.⁸

Modelling studies have illustrated the huge success in averting deaths from COVID-19.⁹ However, in the context of relaxation of protection measures comes increases in the number of cases. Understanding the combined impact of these factors using summary measures of population health is useful, to understand how they are driving changes in population health needs.

Our aim was to monitor changes in overall, and inequalities in, COVID-19 years of life lost to premature mortality (YLL) in Scotland from 2020 to 2021.

METHODS

Death registrations were sourced from National Records of Scotland for 2020 and 2021, including the age, sex and postcode of residence of the individual who died.¹⁰ Deaths in 2020 were from the final register of deaths, whereas deaths in 2021 are treated as provisional. COVID-19 deaths were defined using International Classification of Diseases 10th Revision (ICD-10) codes U07.1 or U07.2 as the underlying cause of death. Our dataset was generated on 08 March 2022, to allow additional time to capture the later registrations of deaths occurring towards the end of 2021. Each death record was matched to a Scottish Index of Multiple Deprivation (SIMD) 2020 deprivation fifth, based on their postcode of residence.¹¹ SIMD uses seven domains to examine the extent of area deprivation: income, employment, education, health, access to services, crime and housing.

Mortality counts were aggregated by 5-year age group. The under-5 years age group was split into under 1 year and 1–4 years, and the upper open-ended age group was set at 95 years and above, to align with the Global Burden of Disease (GBD) 2019 reference life table.¹² YLL estimates were derived by multiplying age group-based mortality counts by the age-conditional remaining life expectancy from the GBD 2019 reference life table.

All analyses were carried out at the level of age group and SIMD quintile to facilitate the calculation of age-standardised rates (ASRs). All ASR findings are presented per 100 000 population. ASRs using midyear population estimates were calculated directly to the 2013 European Standard Population to facilitate comparisons.^{13 14} ASR removes the contribution of differences in underlying population structure between SIMD quintiles. ASRs were used to measure inequality using several metrics. The absolute and relative range differences in ASR were estimated between the most and least deprived fifths. The Relative Index of Inequality (RII) and Slope Index of Inequality (SII) were also measured, which involved fitting a linear regression to the ranked SIMD quintiles and YLL ASR. To estimate the RII, the

SII rate was divided by the total ASR YLL rate. YLL attributable to inequalities in area deprivation were estimated using the least deprived quintile as a reference group.

Sensitivity analysis on the indicators of relative inequality was carried out using the last 6-month period of 2021. This was to detect whether the 2021 estimate was strongly influenced by lower periods of vaccination uptake.

RESULTS

There were 6163 COVID-19 deaths in 2020, which decreased to 4670 in 2021 (table 1). YLL decreased from 94 871 in 2020 to 84 954 in 2021. In 2020, COVID-19 impacted population health for a 10-month period, whereas it impacted for the full 12-month calendar year 2021, which may underplay the extent of progress in 2021. Therefore, the reduction in the monthly average rate between 2020 and 2021 was larger than the changes in the annual rate for deaths and YLL. Average monthly deaths and YLL in 2021 were 37% and 25% lower, respectively, when compared with 2020. The YLL per death increased to 18.2 in 2021 from 15.4 in 2020. Increases in YLL per death were highest in the most, compared with least, deprived areas indicating that the extent of this increase was disproportionate.

There were marked inequalities in COVID-19 YLL by area deprivation in 2020, which were further exacerbated in 2021, a result confirmed across all measures of absolute and relative inequality (table 2).

There was an 11% reduction in the Scottish national YLL ASR between calendar years. ASRs were lower in 2021 for all deprivation quintiles. However, ASRs in the most deprived areas were only 3% lower, compared with 26% lower in the least deprived areas. The absolute difference between the ASR in most and least deprived areas increased from 2024 to 2217. In 2021, the relative difference in ASR indicated that COVID-19 YLL was 3.8 times higher in the most, compared with least, deprived areas, an increase from 2.9 in 2020. The RII also increased from 1.37 in 2020 to 1.70 in 2021, which means that the ASR in the most deprived areas in 2021 was 85% higher than the Scottish national ASR. The absolute difference between the most and least deprived areas, measured by SII, also increased from 2414 in 2020 to 2652 in 2021. The ASR attributable to differences in area deprivation was 41.0% in 2020. This increased to 51.1% in 2021, indicating that over half of the COVID-19 YLL ASR was attributable to inequalities in area deprivation. Sensitivity analysis on the indicators of relative inequality illustrated slightly higher levels of relative inequality in the last 6 months of 2021, compared with the entire 2021 calendar year period (online supplemental table 1).

Table 1 Summary of measures of COVID-19 mortality in Scotland, 2020 and 2021

Area deprivation fifth	2020			2021			2020–2021 change			
	Deaths	YLL	YLL per death	Deaths	YLL	YLL per death	YLL		YLL per death	
							N	%	N	%
Scotland	6163	94 871	15.4	4670	84 954	18.2	–9916	–10.5	+2.8	+18.2
(1) Most deprived fifth	1674	28 740	17.2	1410	28 563	20.3	–176	–0.6	+3.1	+18.0
(2)	1427	22 170	15.5	1133	20 928	18.5	–1242	–5.6	+2.9	+18.9
(3)	1156	17 076	14.8	832	14 297	17.2	–2779	–16.3	+2.4	+16.3
(4)	1031	15 030	14.6	732	12 385	16.9	–2645	–17.6	+2.3	+16.1
(5) Least deprived fifth	875	11 855	13.5	563	8781	15.6	–3074	–25.9	+2.0	+15.1

Numbers have been rounded, which could result in small differences in displayed totals and annual changes as these have been calculated from the source data. N, number; YLL, years of life lost to premature mortality.

Table 2 Inequalities in the age-standardised COVID-19 YLL rate in Scotland, 2020 and 2021

Metric	2020	2021
YLL rate (ASR per 100 000)		
Scotland	1761	1559
(1) Most deprived fifth	3094	3005
(2)	2103	1952
(3)	1480	1232
(4)	1324	1082
(5) Least deprived fifth	1070	788
Measures of inequality		
Absolute difference between most and least deprived fifth (ASR per 100 000 population)	2024	2217
Relative difference between most and least deprived fifth	2.89	3.81
RII	1.37	1.70
SII (ASR per 100 000 population)	2414	2652
Attributable YLL (%)	41.0	51.1

'Attributable YLL' is the theoretical percentage of the YLL rate that could have been averted if all socioeconomic groups had the same YLL ASR as the least deprived group. ASR, age-standardised rate; RII, Relative Index of Inequality; SII, Slope Index of Inequality; YLL, years of life lost to premature mortality.

DISCUSSION

The marked inequalities in COVID-19 YLL in 2020 were further exacerbated in 2021, to the extent that approximately half of COVID-19 YLL was attributable to inequalities in area deprivation. The widening of inequalities in 2021 was confirmed across all measures of absolute and relative inequality. The combination of two factors drives the widening of estimates of inequalities in COVID-19: disproportionate improvements in COVID-19 mortality and unequal changes in the age of death. Despite reductions in COVID-19 mortality, reductions were the smallest in the most deprived areas. This was augmented by increases in YLL per death, where the largest increases were in the most deprived areas. Our sensitivity analysis suggested that relative inequalities in the last 6 months of 2021 were slightly higher, which reflect periods of high vaccination uptake.

In October 2020, the Scottish Government implemented tiered local protection levels. All mainland local authorities imposed the highest level of protection during the first 5 months of 2021, and all areas moved to the lowest levels from mid-July 2021.¹⁵ As these restrictions were driven by specific indicators, local differences emerged at different times. Although areas with the highest levels of deprivation often had the highest protection imposed, such as Glasgow City, similar levels were also imposed in areas with lower levels of deprivation, such as East Renfrewshire.

Published estimates in early February 2022 highlighted that although overall vaccination rates were high, rates varied with level of deprivation.¹⁶ In all persons eligible for vaccination, there was an 8-percentage point (pp) difference in uptake between the most compared with least deprived areas for the first dose. Inequalities in uptake further increased for the second dose (11-pp) and the third or booster dose (20-pp). Inequalities in vaccination uptake is a likely key contributor to our findings. Factors such as job type and the ability to work from home could also influence the direct risk of infection. Structural inequalities, such as the unequal distribution of income, wealth and power, drive inequality in underlying general health. This, in turn, leads to higher levels of vulnerability, disproportionately shouldered by members of Scotland's most deprived communities.

A limitation of this study is that it does not capture the years lived with disability (YLD) through living with ill-health due to COVID-19, to estimate disability-adjusted life years (DALYs).¹⁷ Previous studies have indicated that contribution of YLD to DALYs is likely to be low; however, with the large increase in case numbers and mortality improvements, the YLD contribution in 2021 would be expected to be slightly higher than reported in 2020.¹⁸ The contribution of YLD to DALYs is also likely to be driven by the severity of the dominant variant, which would change over time. However, as uncertainties over the extent of the prevalence, duration and disability from long COVID-19 persist, monitoring the fatal population health impact using YLL yields important insights. The YLL findings alone would be enough to frame the population health loss from COVID-19 mortality as being similar to the pre-pandemic population health losses from lung cancer or drug use disorders.¹⁹ A strength of our study lies in the use of high-quality death registration data.²⁰ Furthermore, using an internationally agreed consensus on the valuation of life lost is a strength, allowing for comparability with other pre-pandemic causes of death, and estimates of COVID-19 YLL from other countries.²¹

Despite a highly impactful vaccination programme in preventing mortality, COVID-19 continues to represent a substantial area of fatal population health loss for which inequalities have widened. As COVID-19 infection has disproportionately impacted the Scottish population due to systemic inequality, the indirect adverse impacts as a result of protective measures have the potential to further widen inequalities.²² Tackling systemic inequalities with effective interventions is required to mitigate further unjust health loss in the Scottish population.²³

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