Inequalities in mortality before and during the pandemic

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Summary

All-cause mortality in England ordinarily has a steep gradient by deprivation. While living in a more deprived area is associated with higher risk of COVID-19 death in absolute terms, the pre-existing all-cause mortality gradient by deprivation has remained broadly stable during the pandemic. However patterns of mortality among ethnic minorities and in densely populated areas have changed, especially considering that (absent the pandemic) there is little difference in all-cause mortality by these factors. Carefully considered efforts will be needed to address the longstanding inequalities in mortality by socioeconomic status, as well as the newly amplified disparities affecting ethnic minorities and people in densely populated areas.

Mortality inequality pre-pandemic

Social and economic circumstances have a long-standing relationship with health. Those living in more deprived circumstances exhibit poorer health than those living in less deprived circumstances. Since 2001 age-standardised all-cause mortality rates in the most socio-economically deprived decile in England have been 1.5 – 2 times higher than mortality rates in the least deprived decile (Link).

Inequalities during the COVID-19 pandemic

The Robert Koch Institute in Germany (Link) noted that people who live in more economically deprived and crowded circumstances may be disproportionately affected by the outbreak of an infectious disease for a variety of reasons including:

- Employment that does not fit well with non-pharmaceutical interventions (e.g. unable to work from home, key workers);
- Lower ability to accommodate a period of illness (e.g. less job security, or greater financial impact of not working creating pressure to work during illness);
- More crowded living conditions (e.g. difficulty self-isolating, higher transmission risk);
- Higher prevalence of co-morbidities).

We have done our own analysis of how pandemic mortality compares against pre-pandemic mortality, with particular regard to deprivation and population density.

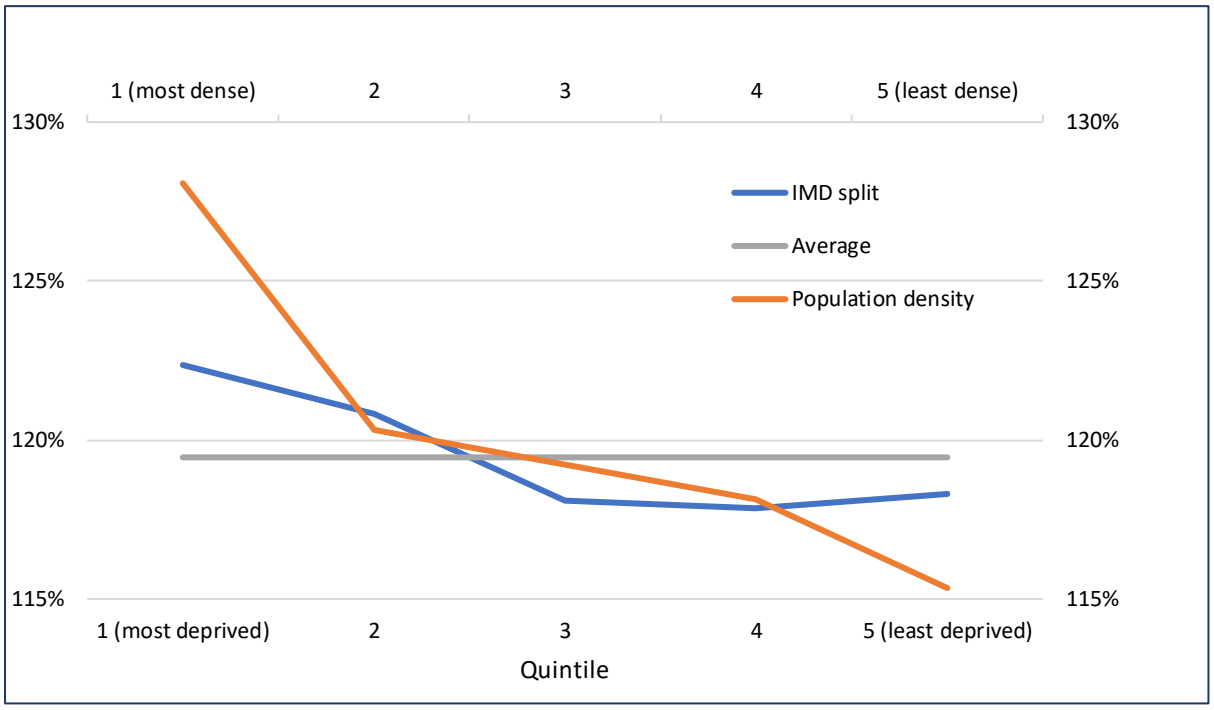
We compare all-cause deaths during the COVID-19 pandemic against deaths in the preceding years at the Middle-layer Super Output Area (MSOA) level by various splits including deprivation and population density. MSOAs typically cover around 8,300 lives.

In England the Index of Multiple Deprivation ('IMD') includes income, employment, education, health, crime, barriers to housing and services and the quality of the living environment. This provides a comparable index of deprivation across the population (Link). For this analysis, we break the English population into quintiles (20% segments) using mid-2019 population estimates aggregated to MSOA level. We did a similar split of the population into quintiles based on population density.

Figure 1 compares death registrations for all causes in the period between March 2020 and January 2021 (Link) against the average annual deaths in these areas between 2017 and 2019 (Link), having adjusted for seasonality (Link). Comparing the IMD split (blue line) with the average (grey line), an additional gradient by deprivation is not clearly noticeable.

However, comparing the population density split (orange line) with the average (grey line), there is a more pronounced gradient. Indeed, there is a 28% increase in deaths in those areas in the densest population quintile compared with a 15% increase in deaths for areas in the least densely populated quintile. These compare with an overall (across the population) increase in deaths of 19.5%.

Figure 1 – Deaths during the pandemic v pre-pandemic deaths, by IMD and population density



This simplistic analysis masks complex dynamics of the underlying mortality inequalities in usual years as well as variations by month during the pandemic.

Table 1 shows how actual deaths compare with expected deaths (where the expected deaths are calculated from ONS population estimates 2017-19 and the ONS English National Life table for 2017-19). The expected deaths allow only for age and gender (Link). The quintiles represent MSOAs ranked by IMD from most to least deprived. The third column of the table shows an Actual vs Expected ratio (A/E) for each quintile relative to the A/E for the least deprived quintile.

By comparing in this way, we can see that mortality is heavier in more deprived areas (159%) compared with the least deprived. This type of analysis shows that in 2017 to 2019 there was a wide disparity in mortality by deprivation. These disparities are also visible in earlier years.

Table 1 – Actual vs Expected deaths in England 2017 to 2019 split by deprivation quintile

IMD Quintile	Actual vs Expected Deaths (A/E)	Ratio of A/E to Quintile 5 A/E
1 = most deprived	132%	159%
2	109%	131%
3	97%	117%
4	90%	109%
5 = least deprived	83%	100%

Figure 2 shows that in October to December 2020 in England there was a wider gap in all-cause mortality by socioeconomic group than is usually the case. Importantly, this was not the case in earlier months. Unequal ability to social distance is one of the suggested drivers of this widening.

Figure 2 – Deaths during the pandemic v pre-pandemic deaths, split by IMD and month

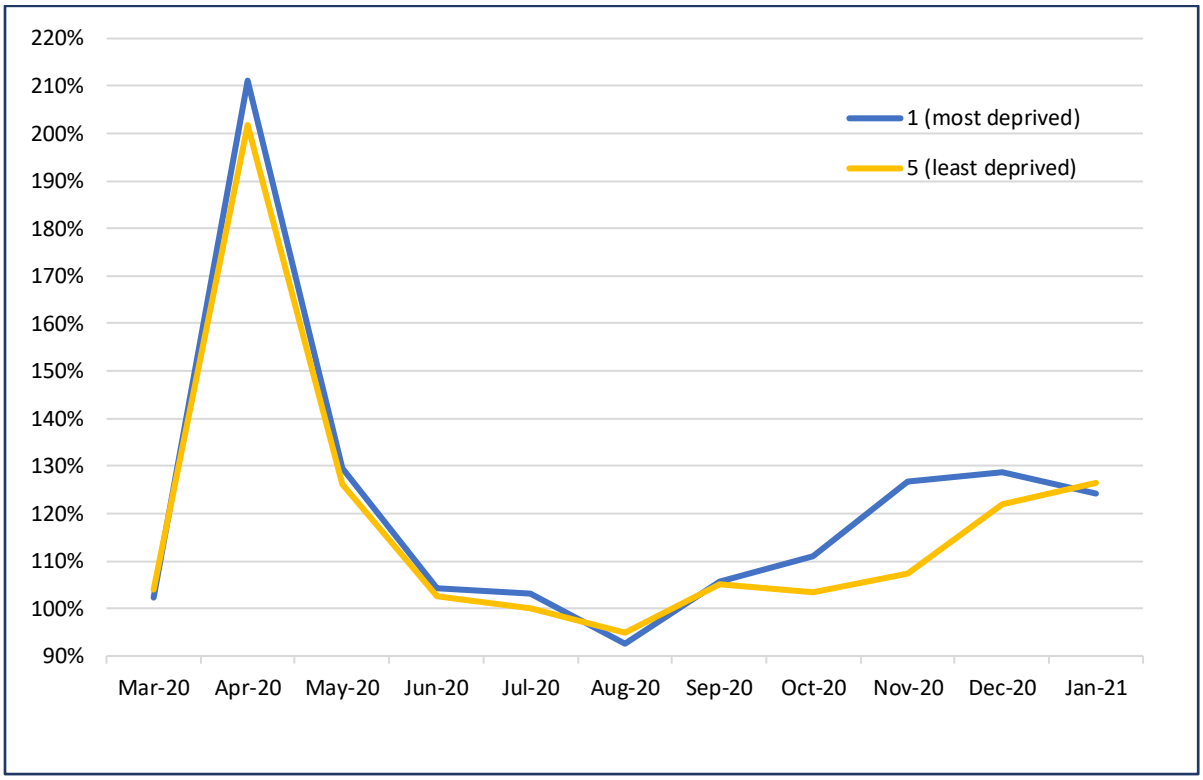


Table 2 shows how actual deaths between 2017 and 2019 compare with expected deaths where MSOAs are ranked by population density. For the 60% of the population that lives in the most densely populated areas, the A/E ratios show deaths are similar (between 103% and 109% of the population average).

By comparing A/E ratios of deaths in densely populated areas with the least densely populated quintile (118% across quintiles 1 to 3), we see less of a difference than when we analyse the population by most and least socioeconomically deprived quintiles.

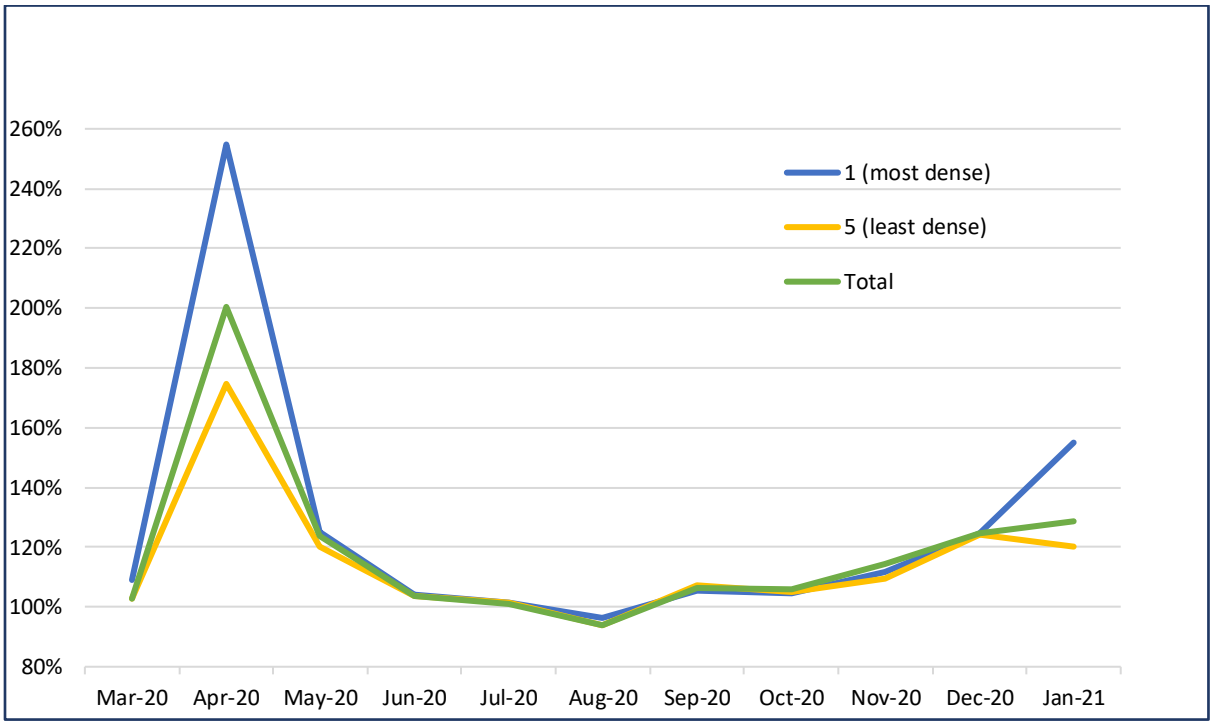
This means that population density ordinarily has a smaller impact on mortality rates than does socioeconomic status.

Table 2 – Actual vs expected deaths in England 2017 to 2019 split by population density quintile

Quintile	Actual vs Expected Deaths (A/E)	Ratio of A/E to Quintile 5 A/E
1 = most densely populated	103%	115%
2	109%	122%
3	103%	115%
4	98%	109%
5 = least densely populated	90%	100%

Figure 3 shows that in April 2020 and January 2021 there was a wider gap in all-cause mortality by population density than usual. These months correspond to the peaks of the first and second waves of the pandemic. For the most densely populated areas, the death count in April 2020 was 255% of normal mortality (i.e. 155% higher than usual), while deaths in the least densely populated areas were 175% of normal mortality. In January 2021, densely populated areas had mortality at 155% of normal mortality; the least densely populated areas, mortality was 120% of normal. These results show that densely populated areas experienced disproportionately high mortality during the pandemic.

Figure 3 – Deaths during the pandemic v pre-pandemic deaths, by population density and month



Does population density explain other observed differences?

Predictors of risk of SARS-CoV-2 infection and COVID-19 hospitalisation and death have been considered in a number of reports and studies (eg Link, Link).

Significant predictors of COVID-19 outcomes include age, region, urban vs rural areas, occupation, ethnicity, household size, deprivation and health status. In the analysis presented here, 2011 Census data is used to map information on occupation, ethnicity, household size and health status at MSOA level (Link). Deprivation scores are assigned using the 2019 English IMD (Link).

The correlation between IMD quintile and population density is -0.34 which means that as population density reduces, so does deprivation but only to some extent. If the relationship were much stronger in this direction, the figure would be closer to -1.

Table 3 shows factors that are strongly correlated with living in a high-density area. It is difficult to identify causal relationships but the table shows that population density is correlated with many of the known COVID-19 morbidity and mortality risk factors.

Living in a high-density area is associated with being from a minority ethnic group, living in London, having qualifications from abroad (typically meant by 'other qualifications') and being of working age.

Living in a low-density area is associated with being of White ethnicity, living in communities with a high proportion of retired people, and having Level 2 or Apprenticeship qualifications (reflecting a range of different trades being practiced).

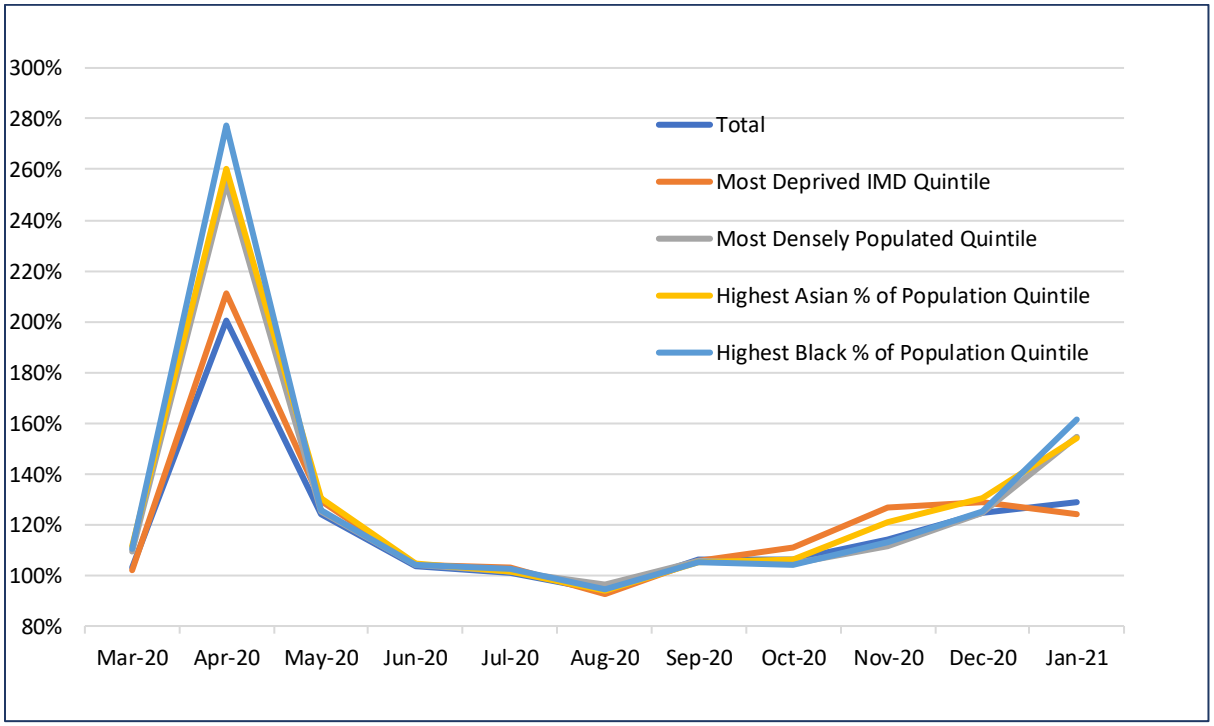
Table 3 – Correlations between population density and other MSOA characteristics

Factor	Correlation with population density
Positive correlations	
Ethnicity: Mixed %	0.67
Qualifications: Other qualifications %	0.62
Region: London	0.60
Age: 18 to 65 %	0.60
Ethnicity: Black %	0.59
Ethnicity: Asian %	0.46
Housing: % of households with 6 plus people	0.42
Negative correlations	
Qualifications: Apprenticeship %	-0.59
Qualifications: Level 2 qualifications %	-0.60
Age: 66 plus %	-0.62
Ethnicity: White %	-0.64

Ethnicity vs population density

While ethnicity and population density are strongly correlated, Figure 4 shows that mortality rates during the pandemic shifted more from the usual expected levels by ethnicity than by population density. During the first and second wave peaks, areas with a higher proportion of Black or Asian residents had higher all-cause death counts (v 201-2019). Between September and December 2020, the pattern was notably different. In this intervening period, excess deaths were most pronounced in more deprived areas, followed by areas with a high proportion of Asian residents.

Figure 4 – Deaths during the pandemic v pre-pandemic deaths, by IMD, density, ethnicity



It is clear just how unusual this disparity by ethnicity is when we compare actual deaths from 2017 to 2019 against expected deaths calculated using the English National Life tables. Normally, mortality is only slightly higher than average in areas with high proportions of Asian or Black residents – as shown in Table 4. Areas with the highest proportions of Asian residents exhibit mortality only 2% higher than the population average; in areas with the highest proportions of Black residents, mortality is only 4% higher than the population average.

Table 4 – Actual vs expected deaths in England 2017-19, split by Asian and Black population percentage

Quintile	Actual vs Expected Deaths (A/E)	Quintile	Actual vs Expected Deaths (A/E)
1 = highest % Asian population	102%	1 = highest % Black population	104%
2	100%	2	104%
3	101%	3	100%
4	100%	4	98%
5 = lowest % Asian population	97%	5 = lowest % Black population	95%

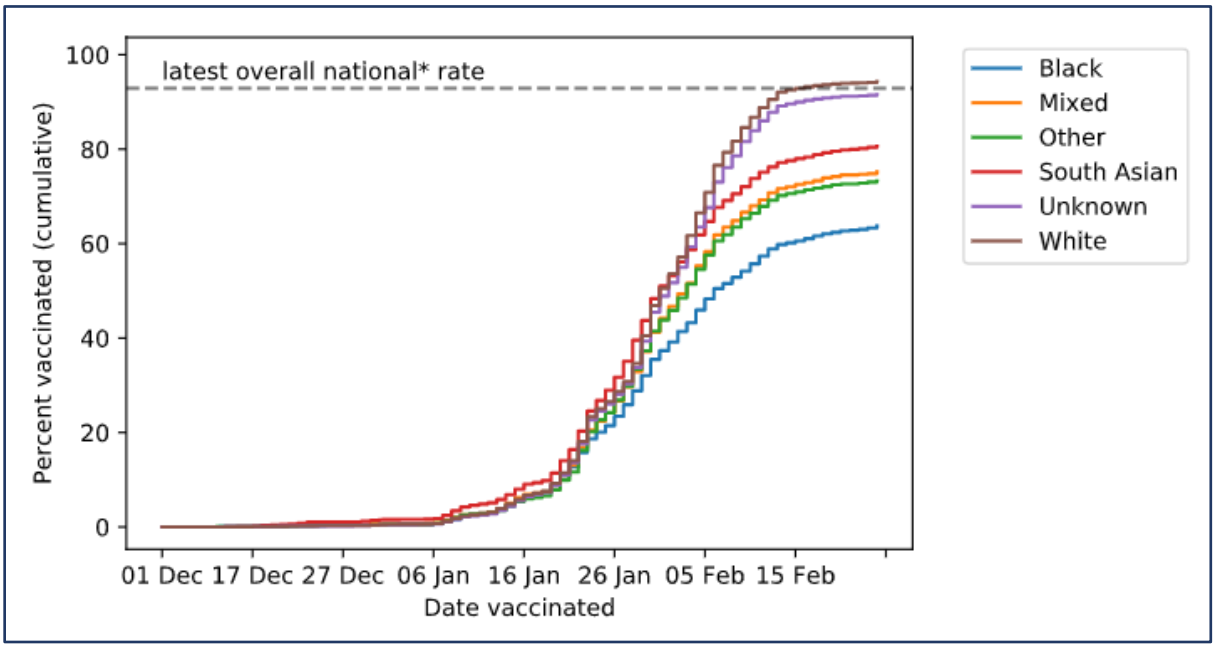
Inequalities in vaccine take-up

To date, vaccine take-up in eligible age groups has been lower among the population groups most likely to be living in densely populated areas. These are the areas worst affected by heavier-than-usual mortality in the pandemic.

In London, 82% of people aged 60 or older had received at least one vaccination dose by 11 March 2021 compared with 90% outside London (Link).

A similar pattern may be seen by ethnicity group as Figure 5 shows that take-up rates are lower among ethnic minority groups (Link).

Figure 5 – Cumulative proportion of 70-79 year olds who have received a vaccine



Conclusion

Pre-pandemic inequalities in mortality by health status and deprivation have persisted throughout the pandemic.

The first and second wave peaks of the pandemic had new, disproportionate effects on certain groups (ethnic minorities, London residents, people living in large households) and these correlate with population density. Population density is not a risk factor normally assumed when looking at mortality.

While policymakers are aware of the longstanding health inequalities by deprivation, COVID-19 has introduced new inequalities by population density and ethnicity. Efforts to reduce the direct and indirect impacts of COVID-19 on mortality require careful consideration of these inequalities.

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