

Responding to COVID-19 in the Liverpool City Region

The Geography of the COVID-19 Pandemic in England

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Map of Liverpool City Region Combined Authority (LCRCA) boundary (in red) and constituent local authorities



Data sources: Westminster parliamentary constituencies (December 2018 - ONS), local authority districts (December 2018 - ONS), and combined authorities (December 2018 - ONS)

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Key takeaways

1. As the pandemic has progressed, high numbers of COVID cases have concentrated in post-industrial communities characterised by historically and geographically embedded forms of inequality, especially in the north of England.
2. A range of structural inequalities can explain the uneven distribution of COVID-19 cases across Upper Tier Local Authorities (UTLAs) in England.
3. By identifying key factors related to structural patterns of inequality that underpin the spread of COVID-19, we highlight potential priority areas of local policy focus.
4. In the Liverpool City Region, our findings suggest that multiple deprivation, an inability to work from home and relative dependency on public transport are key predictors of high numbers of COVID-19 cases.
5. Place-focused policies and funding mechanisms are needed to address inequalities that have widened during the pandemic, and interventions should be led by actors and institutions familiar with particular local contexts such as local public health teams.

1. Introduction

The geography of the COVID-19 pandemic

COVID-19 has had profound consequences with over 1.77 million positive cases and 62,566 deaths recorded to date (as of 10th December) in the United Kingdom, and record rates of unemployment and economic decline during 2020. Yet, whilst labelled by some as the “great leveller”, Richmond-Bishop (2020) argues that ‘COVID-19 doesn’t discriminate but society does’. Initial evidence suggests that the impacts of COVID-19 are unevenly distributed - both socially and spatially - disproportionately impacting the most disadvantaged communities (Haque et al. 2020; Harris 2020).

Whilst a [wide range of dashboards](#) have tracked the spread of COVID-19 cases across England, evidence of the relationship between cases and broader social, economic and demographic characteristics of areas is limited and has focused on the first wave of the pandemic (between March and June) (Harris 2020;

Daras 2020). Analysis of the changes in this relationship during the pandemic is scarce. Empirical evidence to challenge misleading narratives about the populations responsible for the spread of the virus, or to underpin locally-specific policies, funding and investment to support the worst affected communities by the pandemic, is lacking. In response, this policy brief analyses the geography of the COVID-19 pandemic in England focusing on three questions:

1. **Spatial** - Where are COVID-19 cases spatially concentrated?
2. **Social** - Which socio-demographic characteristics are most strongly associated with a high prevalence of COVID-19?
3. **Socio-spatial** - Which socio-demographic characteristics are most strongly associated with high COVID-19 cases across different parts of England?

Our findings provide policy-relevant evidence for local government agencies and national government, emphasising the greater urgency for tackling existing

spatial socio-demographic inequalities; and, identifying local contextual factors which can augment the impact of the pandemic. Such evidence is of particular interest to the Liverpool City Region, where levels of [deprivation are acute](#) and where COVID cases rapidly increased during the second wave.

Methodological approach and datasets

To address these questions, we explored changes over time (from March until November) amongst 151 Upper Tier Local Authorities (UTLAs) in England. UTLAs are made up of a number of different types of geographical units: Metropolitan Districts (n = 36), London Boroughs (n = 32) plus the City of London (n = 1), Unitary Authorities (n = 55) plus the Isles of Scilly (n = 1), and County Councils (n = 26). In the reporting of COVID-cases Cornwall and the Isles of Scilly are combined into a single unit, in addition to Hackney and the City of London, leaving a total of 149 UTLA in our analysis.

Our analysis uses daily new COVID-19 cases, retrieved from the [government COVID-19 dashboard](#). We calculated the proportion of cases per 100,000 persons, using mean values for months and specific weeks during the pandemic. COVID-19 cases are combined with a range of [contextual variables](#) retrieved from the 2011 Census, the Indices of Multiple Deprivation (IMD) 2019 and Public Health England. We measured the strength of the relationship between new COVID cases and a set of area-level socio-demographic variables.

To this end, we used a quasi-poisson geographically weighted regression model. This allows for the identification of areas reporting a relatively high number of cases, in relation to the average UTLA in England at a given point in time. Rather than identifying causation, we seek to determine the set of contextual variables

associated with a high incidence of new COVID-19 cases over time.

2. Socio-spatial inequalities relating to COVID-19 cases

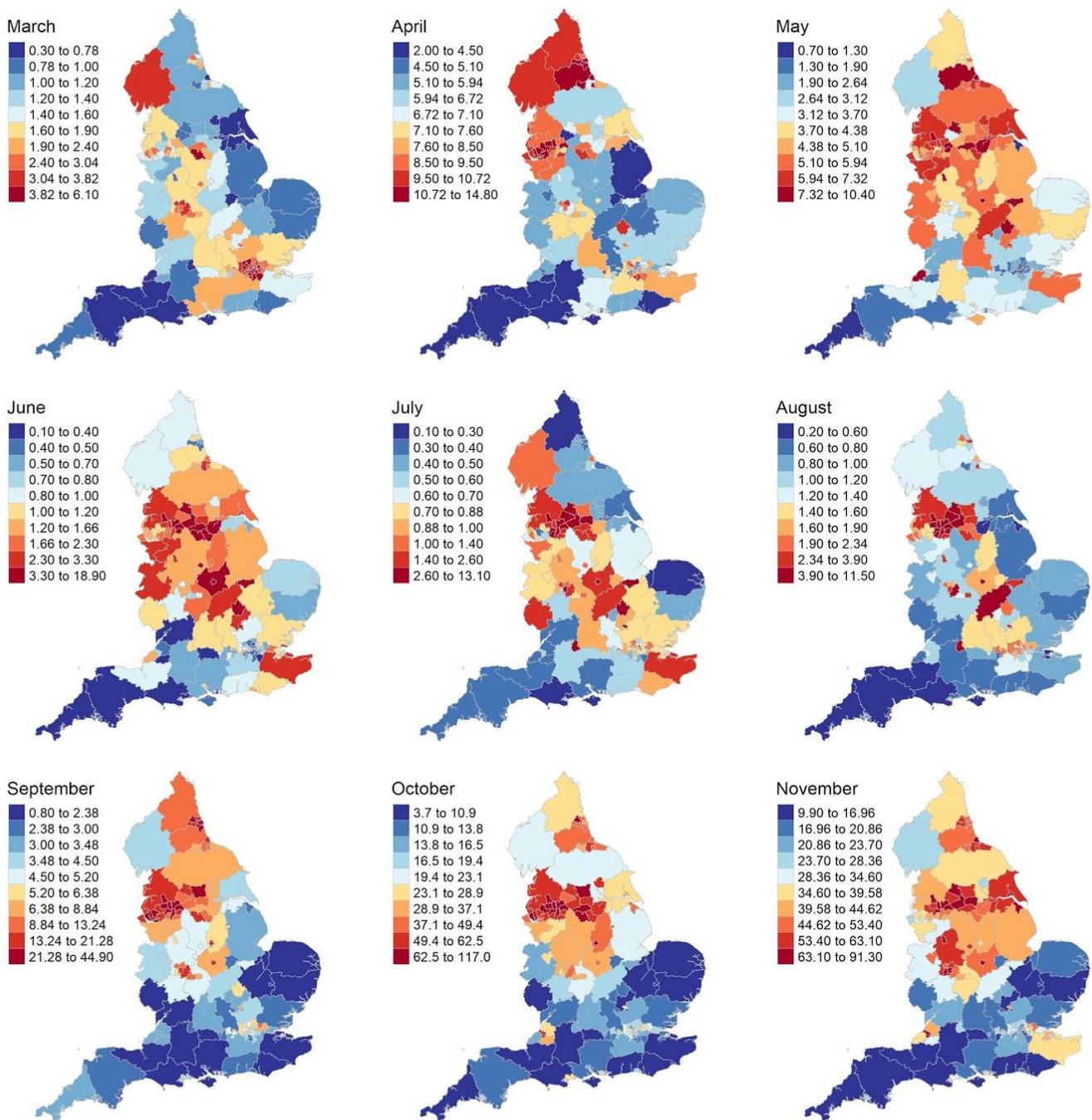
The changing spatial distribution of COVID-19 cases

During March as the pandemic unfolded, relatively high numbers of cases concentrated in Greater London and the West Midlands, areas characterised by global interconnectivity and urban density (Figure 1). Urban UTLA in Greater London recorded some of the highest COVID-19 cases in March (Table 1), although figures were lower than subsequent months partly owing to lower testing capacity during the first wave of the pandemic (e.g. Southwark with 6.09 cases per 100,000 persons).

Subsequently (from April until November) the geography of COVID-19 cases has shifted to concentrate in post-industrial areas in the North of England (e.g. Liverpool City Region; Greater Manchester; Tees Valley and North of Tyne). In relation to the first wave, Harris (2020) argues that the geographical distribution of cases was not a north-south divide – a rudimentary divide that has long typified understanding of inequality in England – but rather an “urban deprivation versus rural divide”.

Yet, arguably, the north-south divide has become increasingly stark, especially during the second wave of the pandemic in September and October. In October, seven of the ten top UTLAs according to COVID-19 cases were in the North West of England, although Nottingham recorded the highest rate with 117.0 COVID-19 cases per 100,000 persons. By November, some of the highest rates of COVID begin to be recorded in UTLAs across the Midlands (e.g. UTLA of Dudley and Stoke-on-Trent).

Figure 1. Relative distribution of average daily COVID-19 cases (per 100,000 persons) per month across UTLAs in England.



Legend: Rate of COVID-19 cases calculated per 100,000 persons.

(Sources: [ONS \(2019\)](#), [gov.uk \(2020\)](#))

Note: The map shows the relative rate of confirmed COVID-19 cases to understand the severity across UTLAs. Areas ranked in the 10% of UTLAs with the highest number of COVID cases per 100,000 persons compared to the rest of England are shaded in red, and those areas ranked in the 10% lowest are shaded in blue.

Table 1. Top (red) and bottom (blue) ten UTLAs according to average daily COVID-19 cases per 100,000 persons

	March	April	May	September	October	November
1	Southwark 6.09	Gateshead 14.8	Peterborough 10.45	Liverpool 34.15	Nottingham 117.0	Kingston-u-Hull 91.3
2	Brent 6.08	Sunderland 14.72	Leicester 9.64	Manchester 33.33	Knowsley 87.4	Oldham 80.9
3	Lambeth 5.86	St. Helens 14.20	Bradford 9.31	Bolton 32.87	Blackburn 84.5	Blackburn 75.4
4	Harrow 5.33	S. Tyneside 13.32	Tameside 8.91	Knowsley 32.47	Liverpool 84.2	Kirklees 72.2
5	Barnet 5.01	Knowsley 13.14	Doncaster 8.83	Newcastle-u-Tyne 27.87	Salford 83.6	Rochdale 70.9
6	Westminster 4.95	Middlesbrough 13.21	Hull 8.58	Bury 24.41	Manchester 83.2	NE Lincolnshire 70.8
7	Wandsworth 4.83	Warrington 12.49	Blackpool 8.45	Halton 24.39	Oldham 81.2	Bradford 70.0
8	Kensington 4.70	Wigan 12.21	Bedford 8.38	St. Helens 23.60	Newcastle-u-Tyne 77.9	Dudley 68.2
9	Croydon 4.57	Darlington 11.30	Barnsley 8.38	S. Tyneside 23.58	Wigan 77.1	Stoke-on-Trent 67.2
10	Sheffield 4.47	County Durham 11.28	Blackburn 8.20	Salford 23.50	Rochdale 76.1	Sandwell 66.3
140	Hartlepool 0.70	Bournemouth 4.21	Hackney 1.19	Norfolk 2.16	Cambridgeshire 9.4	Bracknell Forest 15.9
141	N. Somerset 0.68	Islington 3.91	Wandsworth 1.72	East Sussex 2.06	Wiltshire 9.1	W Sussex 15.6
142	Devon 0.67	Bath 3.79	Hammersmith 1.06	Hampshire 2.05	W. Berkshire 9.1	Devon 15.5
143	Bournemouth 0.66	Wiltshire 3.57	Islington 1.02	Herefordshire 2.05	W. Sussex 8.9	Cambridgeshire 15.4
144	NE Lincoln 0.64	Somerset 3.40	Westminster 1.01	Kent 2.02	Herefordshire 8.8	W Berkshire 15.3
145	York 0.61	Devon 3.14	Camden 1.00	Medway 1.90	Suffolk 8.0	E Sussex 14.7
146	Rutland 0.52	Cornwall 3.12	Tower Hamlets 0.96	Somerset 1.82	Somerset 7.7	Dorset 13.0
147	Somerset 0.46	Dorset 3.09	Kensington 0.94	Suffolk 1.63	E. Sussex 7.0	Suffolk 11.4
148	Isle of Wight 0.44	NE Lincoln 2.35	Torbay 0.91	Dorset 1.51	Cornwall 5.4	Cornwall 10.3
149	Hull 0.26	Rutland 1.96	NE Lincoln 0.67	Isle of Wight 1.06	Isle of Wight 3.7	Isle of Wight 9.9

(Source: [gov.uk](https://www.gov.uk) (2020))

Social inequalities in COVID-19 cases

Figure 2 provides a matrix of Pearson's correlation coefficients, a statistic which tells us about the type (e.g. positive or negative) and strength of the relationship between average daily COVID-19 cases and a range of social, economic and demographic variables. We focus on four time periods:

1. The start of Wave 1 (week commencing 16th March);
2. The peak of Wave 1 (week commencing 6th April);
3. The start of Wave 2 (week commencing 5th October); and
4. The peak of Wave 2 (week commencing 9th November).

At the start of Wave 1, cases concentrated in areas characterised by a high population density, and high proportion of private renting, overcrowding, public transport use and ethnic minority populations. Meanwhile, strong negative relationships are identifiable with variables of older persons, unpaid caring and poor health. As the pandemic progresses, increasingly strong positive relationships emerge between high numbers of COVID cases and poor health, unpaid care, multiple deprivation, inequality in life expectancy, and routine occupations. Meanwhile, a strong negative relationship emerges with the ability to work from home. Whilst high rates of COVID-19 cases amongst student populations at the start of Wave 2 – the beginning of term – attracted significant attention, we identified an insignificant relationship with COVID-19 cases by the peak of Wave 2.

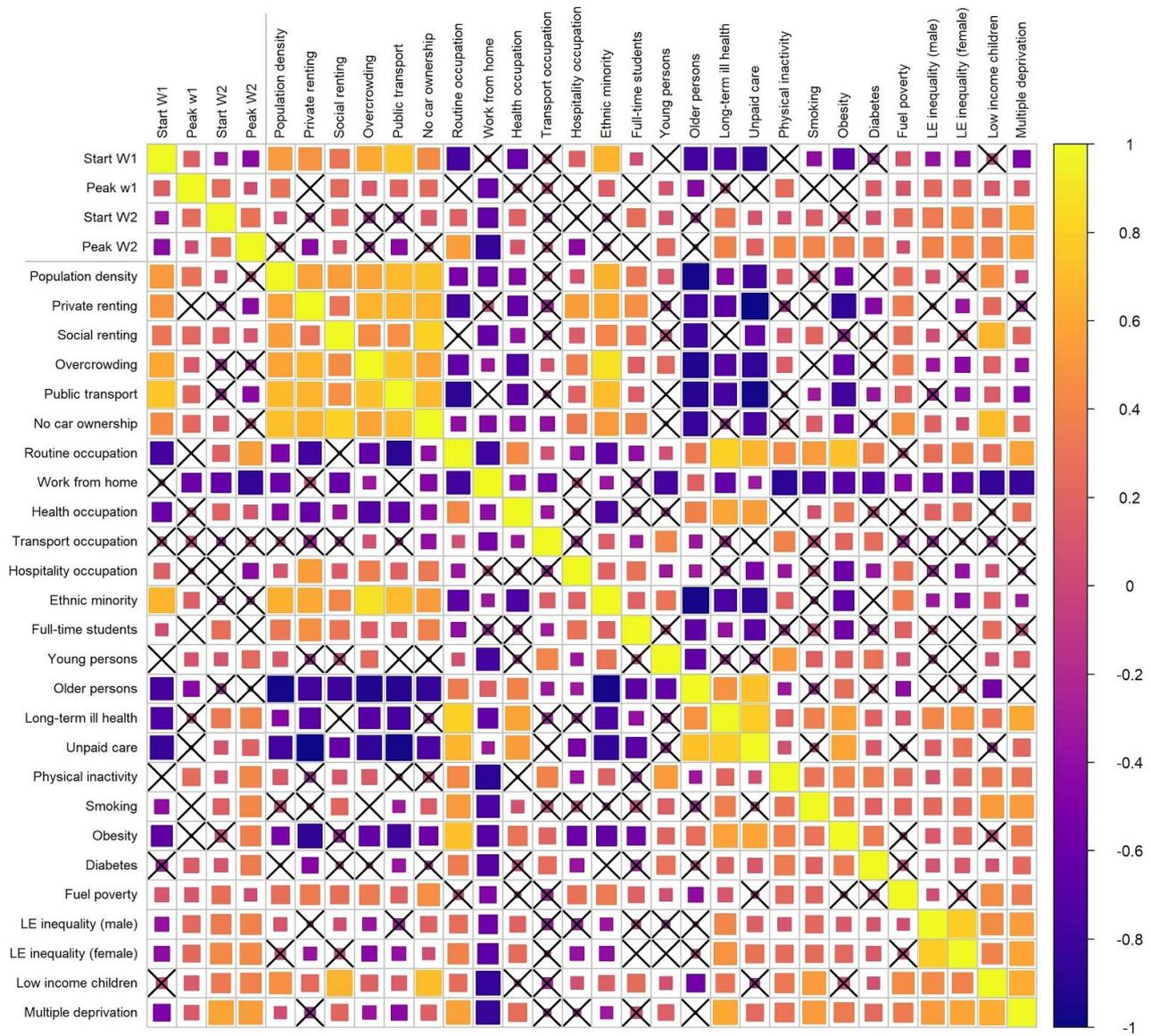
It is important to emphasise that the lack of a relationship between COVID-19 cases and a social variable may obscure a high prevalence of COVID-19 cases in specific subgroups within a population, especially where populations are relatively spatially concentrated (e.g. ethnic minorities, private renters) (Harris 2020).

High numbers of COVID-19 cases amongst subgroups are often better represented by alternative variables. For example, ethnic minority populations disproportionately live in some of the most deprived neighbourhoods in England (Jivraj and Khan 2013).

Figure 3 provides further insight into how the relationship between COVID-19 cases and multiple deprivation – the variable with the strongest relationship with cases during Wave 2 – has evolved over time. During the early stages of the pandemic in mid-March (when lockdown restrictions were first implemented) areas with the highest proportion of neighbourhoods in the most deprived decile had some of the lowest incidence of COVID-19 cases relative to the rest of England. However, by mid-April, cases in the most deprived parts of the country rapidly increased, second only to the most deprived decile, and remained relatively high until May.

Between June and September, cases were relatively low irrespective of the level of deprivation. Yet, during the second wave the number of COVID-19 cases again increased with the level of deprivation. By mid-October, the 10% most deprived UTLAs were recording 3.7 times more COVID-19 cases than the 10% least deprived UTLAs. These trends appear to partially reflect the evolving patterns of COVID-19 cases amongst people experiencing long-term ill health issues, with UTLA home to large shares of populations with poor long-term health recording some of the largest number of COVID-19 cases (Figure 3).

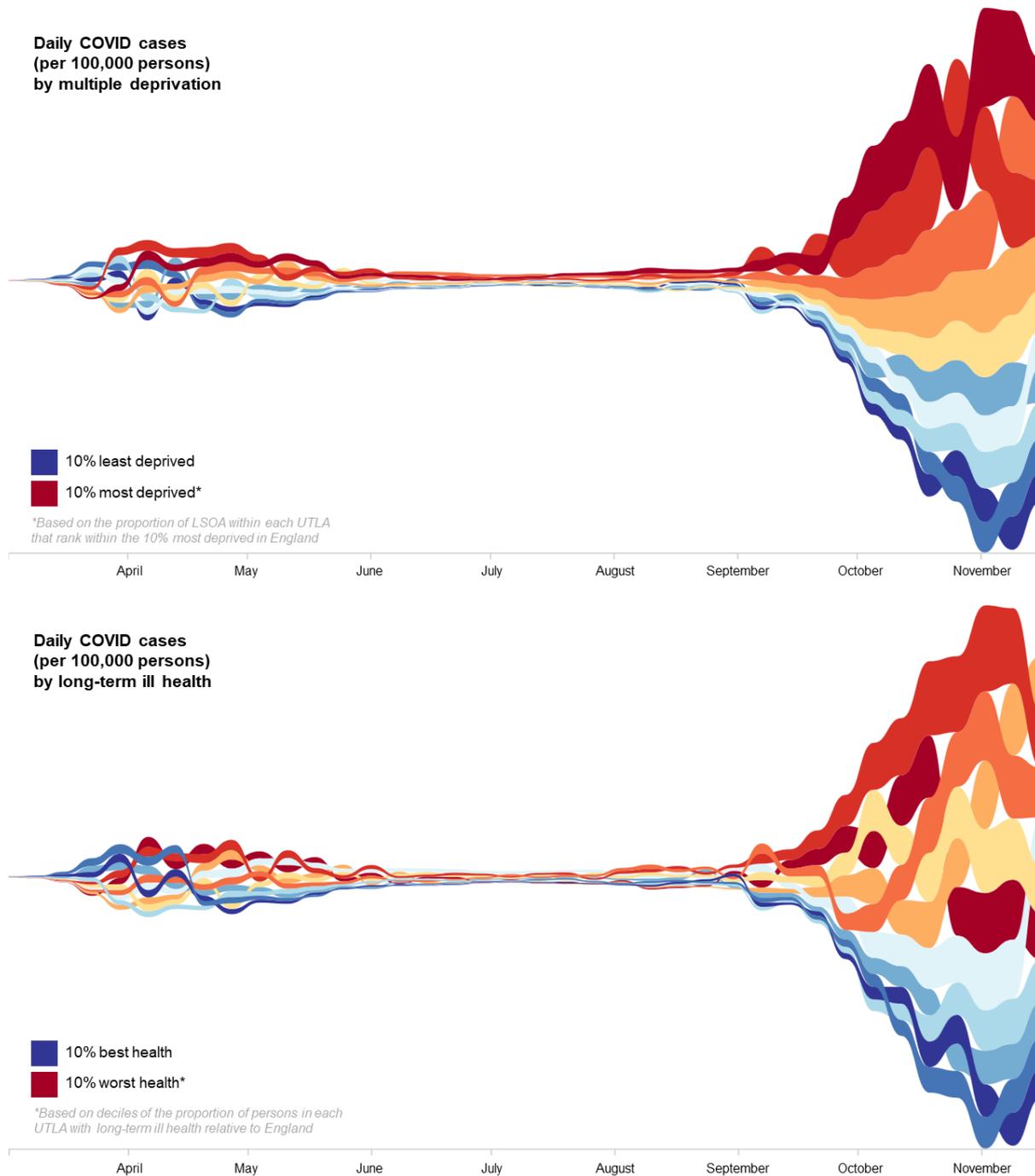
Figure 2. Correlation matrix showing the relationship between mean daily COVID-19 cases for each stage of the pandemic and a range of social, economic and demographic characteristics.



(Sources: [ONS \(2019\)](#), [gov.uk \(2020\)](#), [ONS \(2011\)](#), [PHE \(2019\)](#))

Note: In the correlation matrix, the size of the square reflects the strength of the relationship between two variables. The colour of the square is indicative of the type of relationship, positive (yellow) or negative (blue). A cross indicates where a relationship between two variables is not statistically significant.

Figure 3. Daily COVID-19 cases (per 100,000 persons) by deprivation deciles (above) and long-term ill health deciles (below)



(Source: [gov.uk](https://www.gov.uk) (2020))

Note: The bump chart shows how the number of COVID cases in each deprivation decile changes over time. The graph is sorted according to the relative ranking of each decile – *i.e.* when a deprivation decile appears at the top of the chart it has the most COVID cases. Multiple deprivation is based on the proportion of LSOAs in each UTLA that rank within the most deprived in England. The chart is made using [RawGraphs](https://rawgraphs.io/).

Socio-spatial inequalities in COVID-19 cases

In the previous section, we identified socio-demographic variables closely related to average COVID cases in each wave. This provides an understanding of the evolution of these relationships at the national scale. To explore how these associations vary across UTLAs, we fit geographically weighted regression models for each of our four time periods. A description of our model specification is available [here](#).

What do the model results tell us? By mapping coefficient estimates (Figure 4) we can identify some of the key inequalities that likely underpin the spread of COVID-19 in specific parts of the country. At the start of Wave 1 COVID-19 cases are positively associated with a high proportion of ethnic minority groups and the ability to work from home, especially in northern regions. By the peak of Wave 1 (and similarly at the peak of Wave 2) both positive and negative coefficient estimates across all variables, and the spatial patterns associated, are less stark. This is likely as peaks in cases tend to occur when the virus has already spread across the country.

Comparatively, by the start of Wave 2, long-term illness, students and multiple deprivation assume increasing importance in the prevalence of COVID-19 cases, beyond London and the South East regions. In the Liverpool City Region, strong negative coefficient estimates indicate that a high proportion of people are employed in sectors where it is not possible to work from home, potentially driving high COVID-19 cases in the region.

3. Key findings and policy recommendations

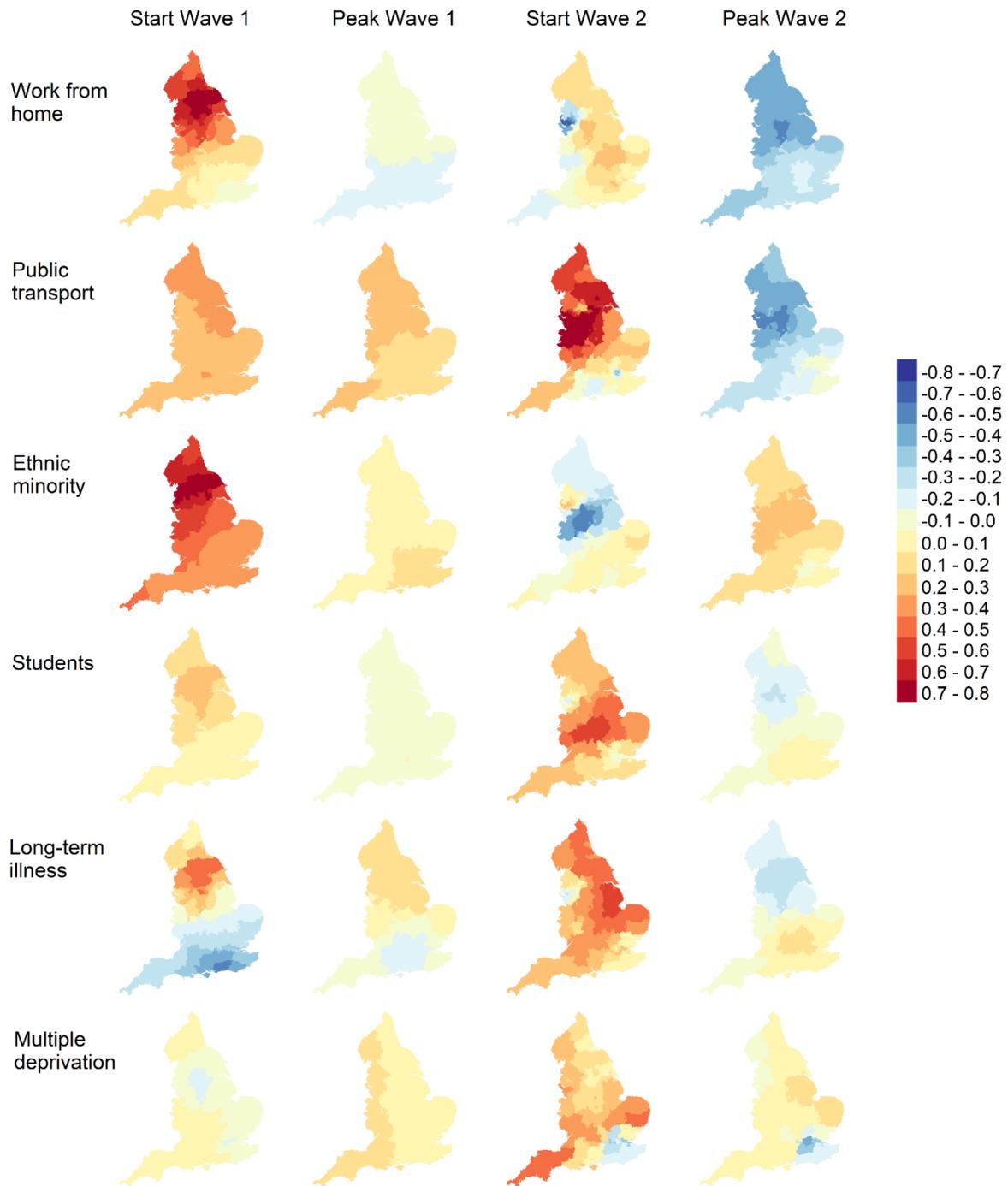
As the pandemic has progressed, high numbers of COVID cases have

concentrated in post-industrial communities characterised by historically and geographically embedded forms of inequality, especially in the north of England. A legacy of underinvestment, austerity and public spending cuts have left these communities disproportionately exposed to the impacts of COVID-19.

A range of structural forms of inequalities are associated with a higher incidence of COVID-19 cases in UTLAs across England. Our analysis identifies some of the key factors related to inequality that underpin the spread of COVID-19 across different regions upon which policy should focus.

Spatially-explicit policies and funding mechanisms are necessary to address existing inequalities that have widened during the pandemic. These should be developed and led by actors familiar with inequalities that characterise particular local contexts, for example, local public health teams.

Figure 4. Selected coefficient estimates for quasi-poisson geographically weighted regression models across Wave1 and Wave 2 of pandemic.



(Sources: [ONS \(2019\)](#), [gov.uk \(2020\)](#), [ONS \(2011\)](#), [PHE \(2019\)](#))

Note: Coefficient estimates tell us how the relationship between the dependent variable and each explanatory variable varies across England, and by how much. For example, at the Start of Wave 1 there is a positive relationship between COVID-19 cases and ethnic minority populations across England, a relationship that is especially strong in the North of England.

4. References

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The code and data to reproduce the analysis is available at: <https://bit.ly/3gPqu4f>

The information, practices and views in this Policy Brief are those of the author(s) and do not necessarily reflect the opinion of the Heseltine Institute.

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