

# An application of matching algorithms to generalise small-area estimates of chronic pain prevalence to neighbourhoods across England

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## Background

Local decision-makers lack granular data on the prevalence of chronic pain in their populations. A previous study, the 'PRELIM' study, had surveyed adults in North Staffordshire and had responses from people living in 230 different neighbourhoods (1).

We therefore asked the question, *To what extent can neighbourhood-level estimates of chronic pain measured in North Staffordshire be generalised to other neighbourhoods in England?*

## Methodology

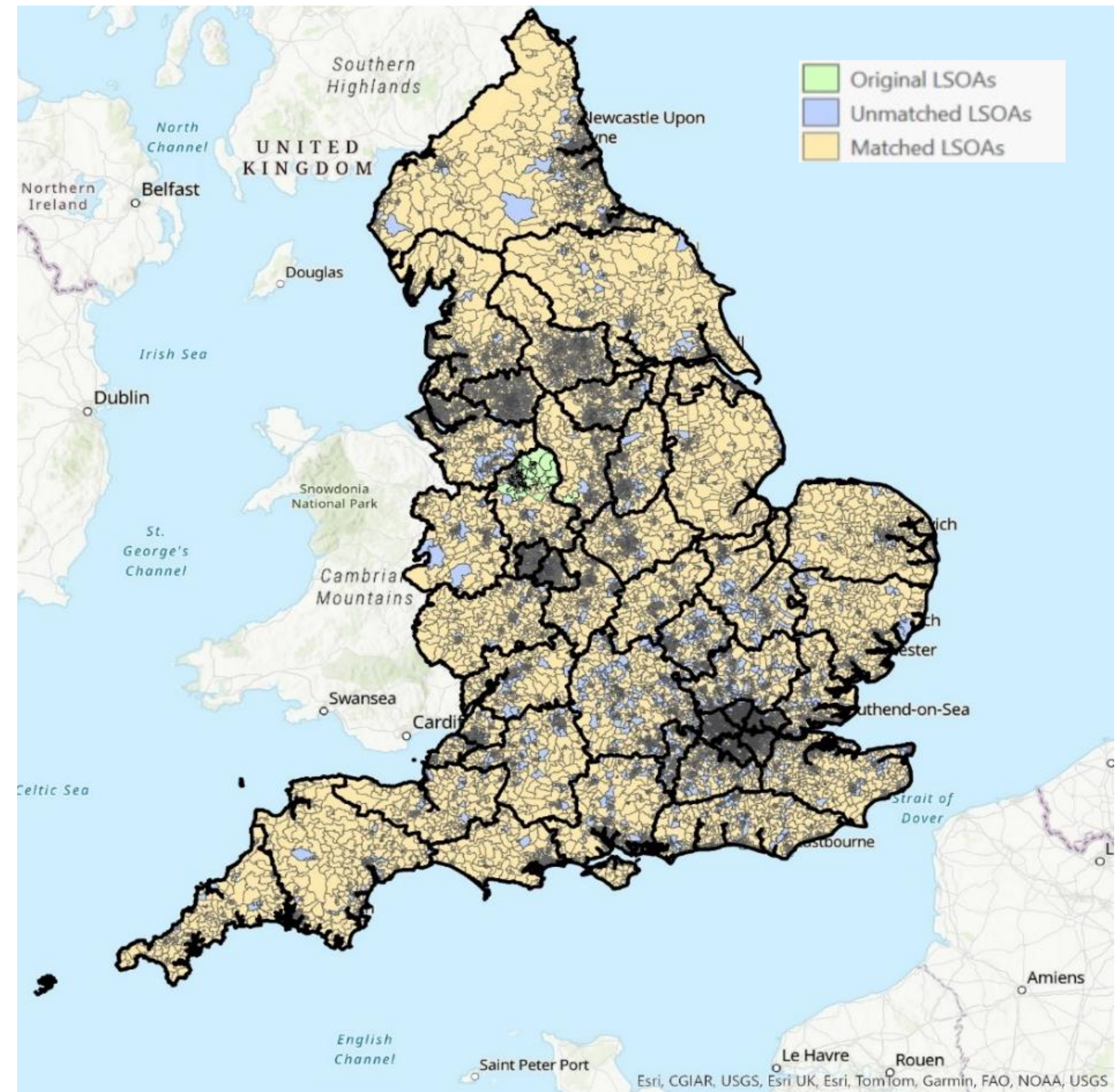
We used three main data sources:

1. Regression model coefficients that had been derived to produce modelled estimates of chronic pain in adults aged 35 years and older at Lower-level Super Output Area (LSOA)
2. Data on age, sex, sex by age, rurality, and ethnicity of all LSOAs in England extracted from Office for National Statistics 2021 Census (datasets TS007A, TS021, RM121, TS008), English indices of deprivation 2019 decile scores, and the 2011 rural/urban classification for LSOA boundaries (2)
3. Shapefiles for 2021 LSOA boundaries and Integrated Care Board boundaries in England obtained from the Open Geography Portal and transformed using ArcGIS, and displayed in Power BI (3) (4)

Matching analyses using propensity scores were performed to match 'control' LSOAs (all LSOAs in England, minus focal LSOAs) to 'focal' LSOAs (LSOAs in North Staffordshire & Stoke-on-Trent that had at least one PRELIM survey respondent).

After comparing the age, sex, deprivation, rurality and ethnicity distributions of focal and control LSOAs, we excluded control LSOAs that were outside the region of common support. We then performed full optimal matching of the remaining control LSOAs to the focal LSOAs. Matching analyses were performed using the MatchIt package, with covariate distributions at each stage assessed using cobalt, both in R 4.3.0 (5).

## Matched and unmatched Lower-level Super Output Areas

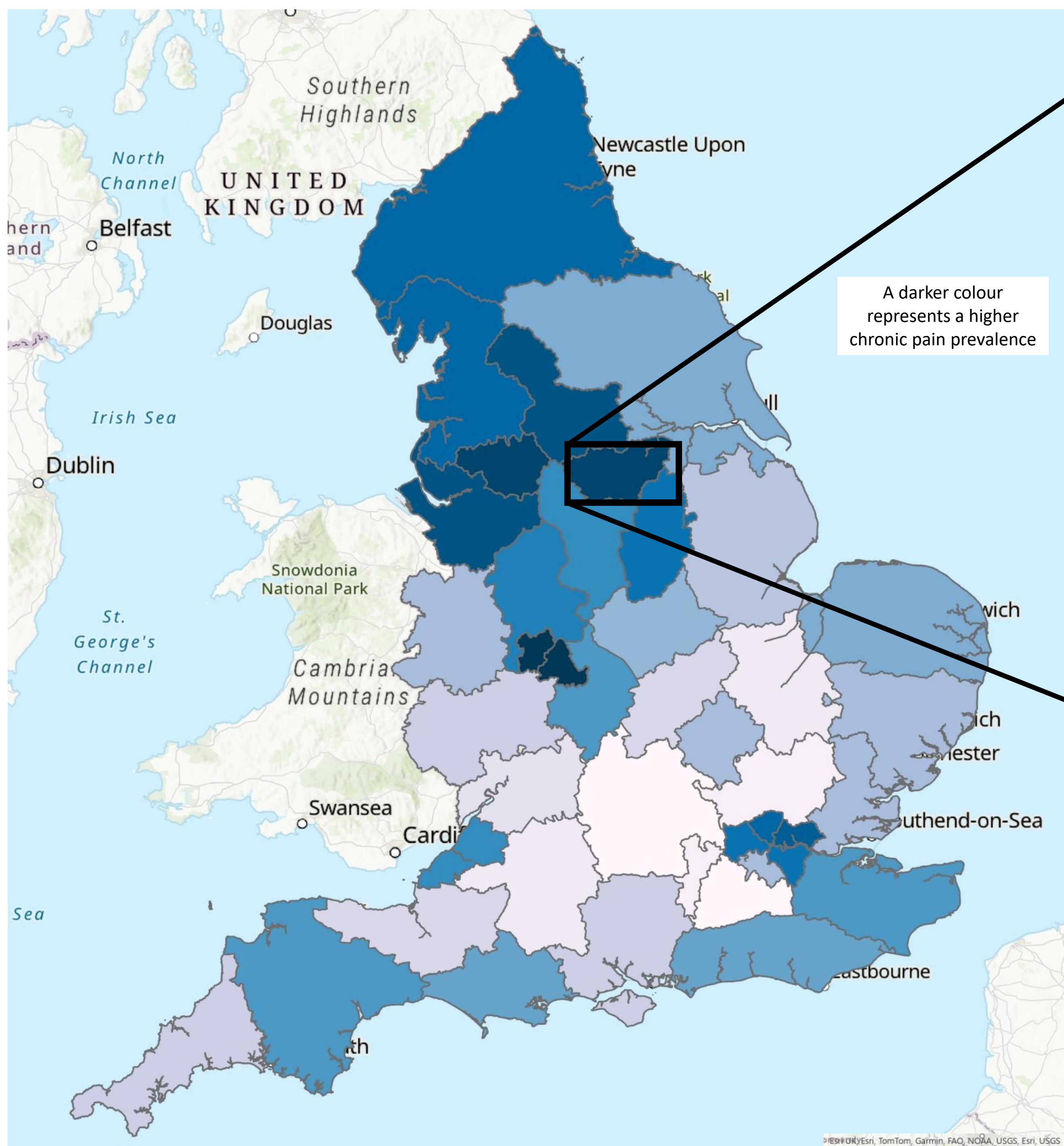


## Results

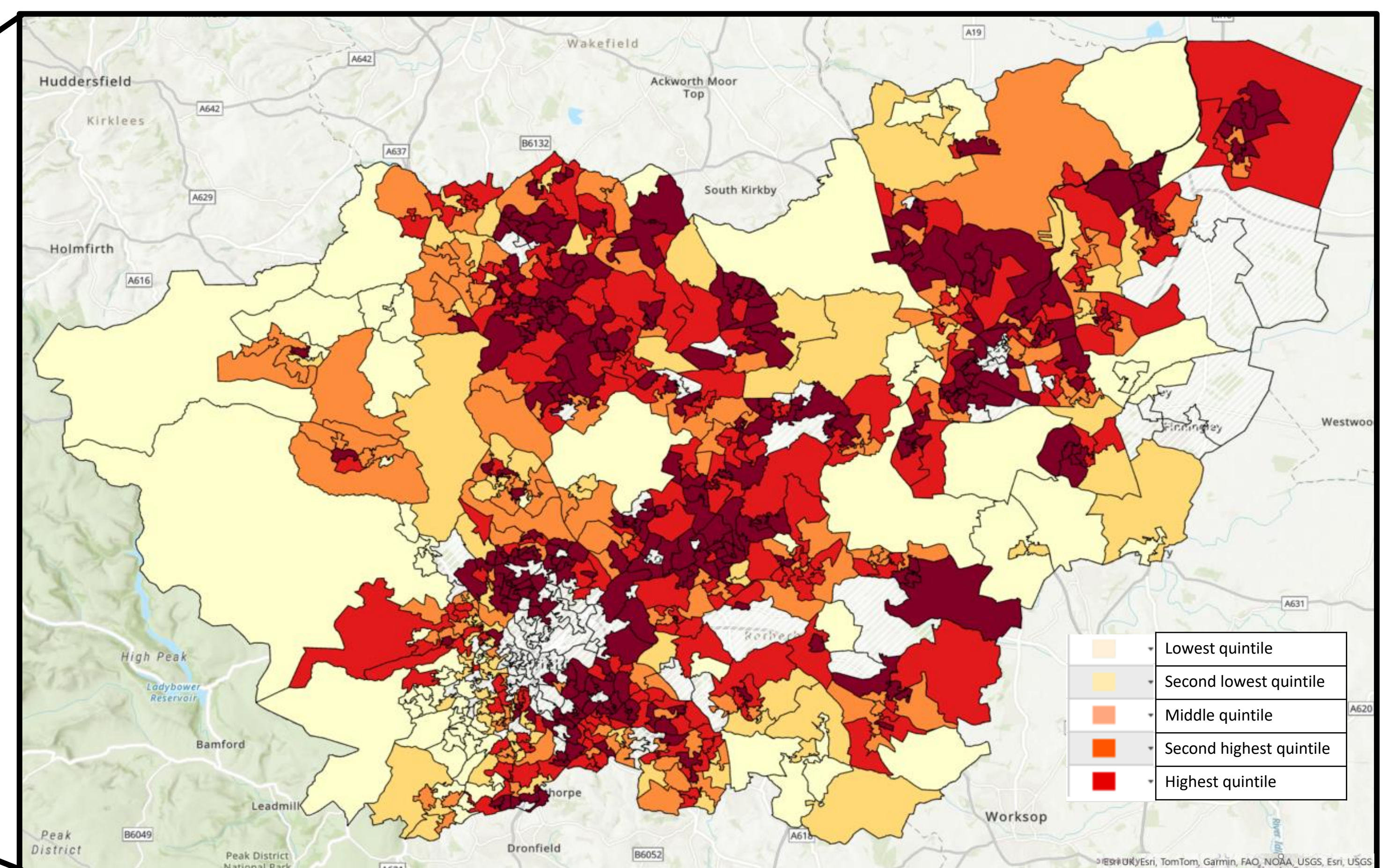
Of 33755 LSOAs in Census 2021, 1945 had no deprivation score at the time of analysis due to boundary changes, leaving a total of 31810 LSOAs with complete data on age, sex, ethnicity, deprivation, and rurality. PRELIM survey respondents came from 230 of these LSOAs across North Staffordshire, Stoke-on-Trent and bordering areas (n=230 'focal' LSOAs). Satisfactory matching was achieved for 24,871 of 31,580 LSOAs (79%). Based on non-overlapping propensity score distributions, a total of 6204 'control' LSOAs were found to be 'off common support', with a further 505 discarded or unmatched during full optimal matching. The 6709 LSOAs identified as either 'off common support' or unmatched were principally inner-city neighbourhoods with younger, more ethnically diverse populations.

LSOA-specific estimates of chronic pain prevalence in the population aged 35+, among matched LSOAs ranged from 14.1% to 50.6%. Integrated Care Board (ICB) estimates ranged from 26.8% in NHS Buckinghamshire, Oxfordshire and Berkshire West ICB to 37.2% in NHS Black Country ICB. The aggregated national prevalence estimate for England was 31.8%.

## Integrated Care Board Estimates of Chronic Pain prevalence



## Lower-level Super Output Estimates of Chronic Pain prevalence



## Conclusion

Using matching methods, we have produced the first detailed map of the distribution of chronic pain in England. Our estimates highlight substantial prevalence variation within ICBs.

This method demonstrates how survey responses from limited LSOAs could be applied to LSOAs across the borough, to local authorities, regions, and England.

**References**  
 (1) - Wilkie R, Yu D, Jordan K, Peat G, Protheroe J, Jinks C, Dunn K, Mamas M, Blackburn S, Dent S, Judge A, Prieto-Alhambra D, Silman A, Walker-Bone K (2020) PRELIM Survey (2017). Keele Data Repository. Available at: <https://doi.org/10.21252/5ag3-1a31>. The data underlying this article are available in [MIDAS OSF], at <https://osf.io/e542w/>.  
 (2) - The datasets were derived from sources in the public domain: [PRELIM regression model coefficients and LSOA-specific estimates for North Staffordshire & Stoke-on-Trent available at <https://onlinelibrary.wiley.com/doi/10.1002/eip.2148>; Office for National Statistics 2021 Census datasets TS007A <https://www.ons.gov.uk/datasets/TS007A/editions/2021/versions/1>, TS021 <https://www.ons.gov.uk/datasets/TS021/editions/2021/versions/1>, RM121 <https://www.ons.gov.uk/datasets/RM121/editions/2021/versions/1>, TS008 <https://www.ons.gov.uk/datasets/TS008/editions/2021/versions/4>  
 (3) - Microsoft PowerBI Version 2.107.683.0 64-bit (July 2022)  
 (4) - Maps throughout this document were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved. For more information about Esri® software, please visit [www.esri.com](http://www.esri.com). Map files were obtained from [Open Geography Portal](https://opengeographyportal.org/)  
 (5) - RStudio.Version(4.3.0)