

Statistical bulletin

Estimating the number of people with cardiovascular or respiratory conditions living in poverty, England: 2021

An experimental analysis estimating the number of people with cardiovascular and respiratory conditions living in poverty in private households in England.

Contact:
Vahé Nafilyan, Piotr Pawelek,
Dan Ayoubkhani
health.data@ons.gov.uk
+44 1633 455046

Release date:
16 December 2022

Next release:
To be announced

Table of contents

1. [Main points](#)
2. [Estimating the number of people with cardiovascular or respiratory conditions living in poverty, England data](#)
3. [Glossary](#)
4. [Measuring the data](#)
5. [Strengths and limitations](#)
6. [Related links](#)
7. [Cite this statistical bulletin](#)

1 . Main points

- [Previous studies](#) show that people with cardiovascular and respiratory conditions have a higher risk of adverse health outcomes, including cold-related hospitalisation and deaths, because living in poverty often exacerbates exposure to cold (for information on the types of cardiovascular and respiratory conditions included in this analysis, see [Section 5: Glossary](#)).
- On 21 March 2021, 6.6 million people (12.1%) had either a cardiovascular or respiratory condition, 3.5 million people had a cardiovascular condition (6.4%), and 3.7 million had a respiratory condition (6.8%).
- Out of the 10.8 million people (20.1%) living in private households who were estimated to be living in poverty, 1.3 million people had a cardiovascular or respiratory condition, representing 2.5% of the population living in private households; 675,000 people (1.2%) had a cardiovascular condition and lived in poverty; 789,000 people (1.5%) had a respiratory condition and lived in poverty.
- Around 20.4% of people with cardiovascular or respiratory conditions lived in poverty; the poverty rate was highest in people with chronic obstructive pulmonary disease (24.4%) and lowest in people who had atrial fibrillation (17.3%).
- The proportion of people who had cardiovascular or respiratory conditions and were living in poverty was particularly high in coastal areas and in the North West. Looking at Lower Tier Local Authorities, it was highest in Blackpool (4.6%), Liverpool (3.9%), South Tyne (3.8%) and Burnley (3.7%); it was lowest in Brentwood (1.5%), South Cambridgeshire (1.5%), Rushcliffe (1.6%) and Richmond upon Thames (1.6%).
- The proportion of people who had cardiovascular or respiratory conditions and were living in poverty was higher in older age groups, in people living in more deprived areas (3.9% for the most deprived areas, 1.7% for the least deprived areas), and slightly higher in males (2.6%) than females (2.4%).
- This analysis builds on previously published [Population estimates for a selection of personal and household characteristics based on Census 2021 responses, England](#) and will be extended to cover other at-risk groups in the future.

These statistics are experimental. Poverty is not directly measured in the data source used for the main analysis. The risk of living in poverty is estimated using a statistical model based on another data source ([see Section 3: Measuring the data](#)). The estimates of poverty rates may therefore differ from official sources and should be interpreted with caution.

Download the data

[.xlsx](#)

2 . Estimating the number of people with cardiovascular or respiratory conditions living in poverty, England data

[Estimating the number of people with cardiovascular or respiratory conditions living in poverty, England Dataset](#) | Released 16 December 2022 An estimation of the number of people with cardiovascular and respiratory conditions living in poverty in private households in England.

3 . Glossary

Respiratory conditions

These include asthma, chronic obstructive pulmonary disease (COPD), and cystic fibrosis.

Cardiovascular conditions

These include coronary heart disease, stroke or transient ischaemic attack, heart failure, peripheral vascular diseases, atrial fibrillation, pulmonary hypertension or pulmonary fibrosis, and congenital heart problems.

4 . Measuring the data

Measuring the size of the population at risk of adverse health outcomes from the cold is essential to support the policy response to increasing fuel prices. People with cardiovascular and respiratory conditions have a higher risk of adverse health outcomes because of the cold. Previous work on [The Health Impacts of Cold Homes and Fuel Poverty](#) has estimated that 40% of excess winter deaths are because of cardiovascular conditions, and a further 33% to respiratory illness.

To estimate the number of people with cardiovascular and respiratory conditions at risk of living in poverty, we combined several data sources, either via record linkage or by imputation.

We used anonymised data from the 2021 Census linked to the [General Practice Extraction Service \(GPES\) data for Pandemic Planning and Research \(GDPPR\)](#) data via NHS number, adjusted for linkage failure, as our population base. The 2021 Census was linked to the NHS Personal Demographics Service (PDS) using a combination of names, date of birth and address, with a linkage rate of 94.6%.

The 2021 Census does not include a direct measure of income or poverty but contains information on household and individual characteristics associated with living in poverty. We used data from the [Family Resources Survey: financial year 2020 to 2021](#) to build a predictive model for living in poverty. The outcome of interest was living in poverty, defined as living in a household with equivalised net household income, after housing costs, of less than 60% of the median income. The predictors used in the model included:

- National Statistics Socio-economic classification (NS-SEC)
- region
- the decile of the Index of Multiple Deprivation
- the age of the oldest member of the household
- the highest educational attainment within a household
- household tenure
- the number of bedrooms
- household size
- the number of adults employed, disabled, with long-term illness

We fitted a logistic regression and a random forest model on a training dataset (80% of the FRS sample), using cross validation to tune the parameters of the models. We compared the performance of each model on a testing sample. The logistic regression model and the random forest model had similar performance, in terms of area under the receiver operating characteristic (ROC) curve and the precision-recall (PR) curve area. The final model was fitted on the full dataset. The code can be found on [GitHub](#).

For the final logistic regression model, the area under the ROC curve was 0.802, and the area under the precision-recall (PR) curve was 0.510. The model showed excellent calibration, with the Hosmer-Lemeshow goodness of fit test indicating that the differences between observed and expected proportions were not significant for each decile of predicted probabilities (p-value: 0.753).

We then used the model to predict the probability for each household included in the 2021 Census to be in poverty.

We used GPPR data to identify people with cardiovascular and respiratory conditions. Respiratory conditions included asthma, chronic obstructive pulmonary disease (COPD) and cystic fibrosis. Cardiovascular conditions included coronary heart disease, stroke or transient ischaemic attack, heart failure, perivascular diseases, atrial fibrillation, pulmonary hypertension or pulmonary fibrosis, and congenital heart problems.

We used evidence of relevant SNOMED codes (diagnosis and prescription) between 1 January 2000 and 21 March 2021 (Census Day) to identify patients diagnosed with respiratory diseases and cardiovascular conditions, except for asthma, where we restricted the period to the last five years. As a result, the prevalence of asthma in our data is lower than as measured by the Quality and Outcomes Framework (QOF). The QOF includes people aged six years and over who have ever had a diagnosis of asthma but excludes those who have been prescribed no asthma-related drugs in the previous 12 months (this methodology could not be replicated for this analysis).

We derived flags for people with any respiratory condition, any cardiovascular condition, any respiratory or cardiovascular condition, and for both respiratory and cardiovascular conditions.

To estimate the number of people with respiratory and cardiovascular conditions and living in poverty, we summed the predicted probabilities for living in poverty for people identified as having these conditions, applying the inverse probability weights to adjust for non-linkage and under-enumeration. These weights were derived using a logistic regression model to model linkage the probability of linking for enumerated census respondents (excluding imputed respondents), as a function of:

- age, (2-year-wide age bands)
- sex
- ethnicity
- religion
- self-reported health and disability
- region
- decile of the Index of Multiple Deprivation
- household tenure
- household deprivation
- household heating type
- National Statistics Socio-economic Classification analytic groups
- highest qualification
- English proficiency
- Standard Industrial Classification
- Standard Occupational Classification
- provider of unpaid care indicator
- economic category

The model was used to derive weights equal to the inverse of the predicted probability of linking.

Collaboration

This work was conducted in collaboration with the Department of Health and Social Care, in particular Lindsay Gardiner, Carol Hunter, and Sophia Donnelly. Clinical input was provided by Professor Christian Mallen and Dr Richard Partington of Keele School of Medicine.

5 . Strengths and limitations

The main strength of these data is that they are based on a population-level dataset, combining the 2021 Census and primary care records at an individual level. The 2021 Census covered around 97% of the population, and therefore is the most representative data source available to produce statistics about the population living in England. The linkage rate from the 2021 Census to the Personal Demographics Service (PDS) was high (94.6%). We adjusted for non-linkage using inverse probability weighting to ensure the linked data were representative of the target population. Data from the data for Pandemic Planning and Research (GDPPR) cover 97.5% of open and active practices, and therefore has a near-complete coverage.

The main limitation is that poverty was not directly measured in the 2021 Census but was modelled using data from the Family Resource Survey. While the statistical model had good accuracy and calibration, the resulting data should be interpreted cautiously. While the 2021 Census data covers most of the population, and linkage rate to the PDS was high, and we adjusted for non-linkage using inverse probability weighting, the data may not necessarily be fully representative of some particular subgroups of the population. Another limitation is that the conditions are based on diagnoses in primary care data. Some people may have these conditions but not have received a diagnosis. Another limitation is that our analysis is a snapshot of the population on 21 March 2021, and we cannot be certain whether the prevalence of some of the conditions has changed since then.

6 . Related links

[The impact of winter pressures on adults in Great Britain: December 2022](#)

Article | Released 15 December 2022

First insights from our new winter survey providing monthly updates on how increases in the cost of living and difficulty accessing NHS services are impacting people's lives during the autumn and winter months.

[Population estimates for a selection of personal and household characteristics based on Census 2021 responses, England](#)

User requested data | 8 November 2022

This dataset provides data tables from the 2021 Census that classify all usual residents living in households responding to the 2021 Census by selected personal and household characteristics.

[The Health Impacts of Cold Homes and Fuel Poverty](#)

Web page | May 2011

A report published by the Institute of Health Equity reviewing the existing evidence of the direct and indirect health impacts suffered by those living in fuel poverty and cold housing.

7 . Cite this statistical bulletin

Office for National Statistics (ONS), released 16 December 2022, ONS website, statistical bulletin, [Estimating the number of people with cardiovascular or respiratory conditions living in poverty, England: 2021](#)