

Impact of multiple cardiometabolic conditions requiring hospitalisation on monthly employee earnings and employment status, England: April 2014 to December 2022

The change in monthly employee earnings and probability of being a paid employee following hospital admission for one, two or three cardiometabolic long-term conditions. This work was commissioned by NHS England.

Contact:
National Statistician's Analysis
Unit
nso_analysis_unit@ons.gov.uk
+44 1329 444110

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1 . Main points

- This analysis investigated the impact of having multiple cardiometabolic conditions (combinations of chronic kidney disease (CKD), cardiovascular disease (CVD) and diabetes) on earnings and employment, and whether the ordering of the onset of these conditions affected on labour market outcomes differently.
- We found a consistent loss of earnings and lower probability of being in paid employment after hospitalisations for each cardiometabolic condition individually, and for most combinations of conditions.
- In individuals with one pre-existing cardiometabolic condition, being additionally hospitalised for CKD showed the greatest reduction in average earnings of all cardiometabolic conditions; there were five-year losses of £6,090 for individuals with pre-existing CVD, and £14,594 in those with pre-existing diabetes.
- Being additionally hospitalised for CKD showed the greatest reduction in probability of being in paid employment of all cardiometabolic conditions; there was a 4.1 percentage point reduction at four-years post-hospitalisation in individuals with pre-existing CVD, and 9.0 percentage points in those with pre-existing diabetes.
- In those with two pre-existing cardiometabolic conditions, being additionally hospitalised for CKD showed the greatest reduction in earnings and probability of employment of all cardiometabolic conditions, with average five-year earning losses of £7,765 and a four-year employment probability reduction of 4.4 percentage points in people with pre-existing CVD and diabetes.

All the datasets used for this analysis have been de-identified in a secure virtual environment before they are combined and analysed. In line with the [Code of Practice for Statistics](#), the de-identified linked data will only be used for statistical production and research. Read more in [Section 5: Data sources and quality](#).

NHS England commissioned this analysis from the Office for National Statistics (ONS) to better understand the economic consequences of cardiometabolic disease for individuals and society. Using linked administrative data, the research measures changes in monthly employee earnings and the likelihood of remaining in paid employment following hospital admission for one, two or three cardiometabolic long-term conditions. The findings will help inform decisions on prevention, treatment and support for people living with multiple long-term conditions.

2 . Results of the analysis

In this release, we report how the combination and sequence of multiple cardiometabolic long-term conditions requiring hospitalisation affect an individual's monthly earnings and their ability to work. These conditions include:

- cardiovascular diseases (CVD)
- diabetes
- chronic kidney disease (CKD)

We also extend our analysis by investigating individual subtypes of CVD, further breaking these down into:

- myocardial infarction
- stroke
- heart failure

See our accompanying dataset for full results of these subtypes.

We applied fixed effects regression modelling to estimate average changes in monthly earnings, and the probability of paid employment that are attributable to having multiple cardiometabolic conditions that required hospitalisation. For definitions of the model applied, see [Section 4: Glossary](#).

Individuals could have one, two, or all three conditions (CVD, CKD, and diabetes). This approach resulted in 12 distinct cohort combinations, defined by the condition of interest and the presence of none, one, or two preceding conditions. For further information on the methods used in this analysis, see [Section 5: Data Sources and Quality](#).

The results presented in this bulletin relate to the additional impact of the condition of interest, rather than the total impact of having all of the conditions in combination.

In our previous publication, [Impact of health conditions requiring hospitalisation on earnings, employment and benefits receipt, England: April 2014 to December 2022](#), we reported the impact of having, CKD, CVD and diabetes on monthly employee earnings and the probability of being in paid employment. In this sample, we estimate the five-year average loss in earnings as:

- £10,671 for CKD
- £5,143 for CVD
- £4,183 for diabetes

There are several differences between these figures and those in our previous publication, which investigated single conditions. Firstly, the non-exposed group in this publication are disease free and the exposed group includes people who only ever had a code for the condition of interest and who did not have a history of the other two conditions.

Figure 1 shows the main results for the impact of hospitalisation for CKD, CVD, or diabetes and their comorbidity on earnings.

Figure 1: Individuals hospitalised for CKD with a pre-existing cardiometabolic condition experienced larger reductions in average monthly earnings than those without a pre-existing cardiometabolic condition

Average changes in monthly employee earnings, England, 1 April 2022 to 31 December 2022

Notes:

1. Data include individuals who had a first hospital admission for the index condition between 1 April 2014 and 31 December 2022.
2. Month 0 is the month in which the first hospital admission for the index condition occurred.
3. The error bars are 95% confidence limits.
4. Pay is gross monthly earnings paid to employees, in 2023 equivalent values.
5. Being a paid employee is defined as receiving a monthly pay greater than £0.
6. The reference period, to which all time periods are compared, is condition dependent ranging from 6 to 12 months to 24 to 30 months before hospitalisation to account for the variation in condition progression before hospitalisation; they are not shown on the graph and are in the six months before the first bar.
7. For each cohort, non-exposed groups were created to enable adjustment for time-varying confounders that would otherwise be collinear with the within-individual treatment effect among exposed individuals. For each index condition cohort, a corresponding non-exposed group was constructed comprising individuals with the same combination of preceding conditions but without the index.

Compared with the pre-hospitalisation reference period, individuals hospitalised for CKD with a pre-existing cardiometabolic condition experienced larger reductions in average monthly earnings than those hospitalised for CKD without pre-existing cardiometabolic conditions.

The decline in average monthly earnings among individuals hospitalised with CKD with:

- pre-existing CVD was £143 in months 0 to 6, with a peak reduction in 6 to 12 months of £155.
- pre-existing diabetes was £199 in months 0 to 6, with peak reductions at 18 to 24 months of £285

Average total loss of earnings over five years post-hospitalisation for these cohorts were £6,090 and £14,594, respectively.

Hospitalisation for CKD among individuals with both pre-existing CVD and diabetes saw a decline in monthly earnings of:

- £174 at 0 to 6 months and peaked around 6 to 12 months of £182, compared with the pre-hospitalisation period

Average total loss of earnings over five years post-CKD hospitalisation in individuals with both pre-existing CVD and diabetes was £7,765.

Figure 2 shows the main results for the impact of hospitalisation for CKD, CVD, or diabetes and their comorbidity on probability being in employment.

Figure 2: Individuals hospitalised for CKD with a pre-existing cardiometabolic condition experienced larger reductions in the probability of being in paid employment than those without pre-existing cardiometabolic conditions

Average changes in the probability of being in paid employment, England, 1 April 2022 to 31 December 2022

Notes:

1. Data include individuals who had a first hospital admission for the index condition between 1 April 2014 and 31 December 2022
2. Month 0 is the month in which the first hospital admission for the index condition occurred.
3. The error bars are 95% confidence limits.
4. Being a paid employee is defined as receiving a monthly pay greater than £0.
5. The reference period, to which all time periods are compared, is condition dependent ranging from 6 to 12 months to 24 to 30 months before hospitalisation to account for the variation in condition progression before hospitalisation; they are not shown on the graph and are in the six months before the first bar.
6. For each cohort, nonexposed groups were created to enable adjustment for timevarying confounders that would otherwise be collinear with the withinindividual treatment effect among exposed individuals. For each index condition cohort, a corresponding nonexposed group was constructed comprising individuals with the same combination of preceding conditions but without the index condition during followup.

Compared with the pre-hospitalisation period, the largest reduction in the probability of being in paid employment was in individuals hospitalised with CKD with pre-existing CVD, decreasing by 4.4 percentage points at 0 to 6 months post-hospitalisation.

The largest decrease in probability of being in paid employment in this cohort reached:

- 6.3 percentage points at 12 to 18 months, and persisted at a 6 to 3 percentage-point deficit up to five years post-hospitalisation

Corresponding values in individuals hospitalised with CKD with pre-existing diabetes were:

- 7.1 percentage points at 0 to 6 months and negative 9.8 percentage points at 18 to 24 months, with reductions persisting at a 9 to 7 percentage-point reduction thereafter

Figure 3 shows the main results for the impact of hospitalisation for CVD, CVD or diabetes and their comorbidity on earnings among those in paid employment.

Figure 3: Among those in paid employment, individuals hospitalised for CKD with a pre-existing cardiometabolic condition experienced larger reductions in average monthly earnings than those without pre-existing cardiometabolic conditions

Average changes in monthly employee earnings among those in paid employment, England, 1 April 2022 to 31 December 2022

Notes:

1. Data include individuals who had a first hospital admission for the index condition between 1 April 2014 and 31 December 2022
2. Month 0 is the month in which the first hospital admission for the index condition occurred.
3. The error bars are 95% confidence limits.
4. Pay is gross monthly earnings paid to employees, in 2023 equivalent values.
5. Being a paid employee is defined as receiving a monthly pay greater than £0.
6. The reference period, to which all time periods are compared, is condition dependent ranging from 6 to 12 months to 24 to 30 months before hospitalisation to account for the variation in condition progression before hospitalisation; they are not shown on the graph and are in the six months before the first bar.
7. For each cohort, nonexposed groups were created to enable adjustment for timevarying confounders that would otherwise be collinear with the withinindividual treatment effect among exposed individuals. For each index condition cohort, a corresponding nonexposed group was constructed comprising individuals with the same combination of preceding conditions but without the index condition during followup.

Further detail on this analysis, descriptive statistics, estimated total economic impacts, and the subtype data and results can be found in our accompanying datasets.

3 . Data on the impact of multiple cardiometabolic conditions requiring hospitalisation on monthly employee earnings and employment status

[Impact of multiple cardiometabolic conditions requiring hospitalisation on monthly employee earnings and employment status. England: April 2014 to December 2022](#)

Dataset | Released 29 June 2026

The change in monthly employee earnings and probability of being a paid employee following hospital admission for one, two or three cardiometabolic long-term conditions.

4 . Glossary

Health conditions

We identified conditions using the International Classification of Diseases 10th Revision (ICD-10) diagnosis codes in NHS England's Hospital Episode Statistics dataset. ICD-10 code lists were developed with input from NHS clinical leads. The three conditions (chronic kidney diseases (CKD), cardiovascular diseases (CVD) and diabetes) were defined in the same way as our previous publication, [Impact of health conditions requiring hospitalisation on earnings, employment and benefits receipt. England: April 2014 to December 2022](#).

- chronic kidney disease, including all stages (1 to 5) of the disease
- diabetes, including types 1 and 2
- cardiovascular diseases, including all types of cardiovascular disease, such as myocardial infarction, stroke, and heart failure (which are also looked at separately); transient ischemic attacks are excluded from stroke and cardiovascular disease

Multiple long-term conditions (MLTCs) or multimorbidity

In line with the [National Institute for Health and Care Research's definition](#), multiple long-term conditions (MLTCs) refer to the co-existence of two or more chronic physical or mental health conditions in the same individual. This is also sometimes referred to as multimorbidity. In this release, we focused on cardiometabolic MLTCs.

Index condition

The index condition in our study was defined as the most recent condition an individual was hospitalised for between 1 April 2014 to 31 December 2022, reflecting the availability of linked pay records to utilise. If an individual had two or more first-time hospitalisations for a condition of interest within this time period, the most recent condition was the index condition.

Confidence intervals (CI)

A confidence interval (CI) is a measure of the uncertainty around a specific estimate. If a CI is calculated at the 95% level, it is expected that the interval will contain the true value on 95 occasions, if repeated 100 times. The level of uncertainty about where the true value lies increases as intervals around estimates widen. More information is available on our [Uncertainty and how we measure it for our surveys page](#).

Fixed effect regression models

A fixed effects regression model is a statistical model that can be applied to panel data, where there are multiple measurements per individual. Within the fixed effects model, an individual's labour market status at any point is compared with their own previous status. This means that the model controls for all factors that do not change over time and that influence the likelihood of medical treatment and labour market status (sources of time-invariant confounding).

Sources of time-varying confounding (such as calendar time and ageing) are accounted for by including them as additional terms in the fixed effects regression model.

Our fixed effects models also controlled for a time-varying comorbidity indicator. This is based on a 12-month "look back" period to capture any hospital inpatient contacts, excluding admissions where the primary hospital diagnosis was the conditions of interest. The 12-month "look back" period was re-derived for the subtypes analysis, given that individuals' prevalent health condition definitions could have changed from the main analysis.

5 . Data sources and quality

Linked dataset

We used an extension of the Public Health Data Asset (PHDA) to include data on employee pay and employment. The de-identified, linked dataset includes:

- Census 2011
- Hospital Episode Statistics (HES) Admitted Patient Care (APC) and Outpatients (OP) records from 1 April 2009 to 31 December 2022
- Office for National Statistics (ONS) death registrations, covering deaths registered from 1 April 2014 to 31 December 2022 and registered by 31 December 2022
- Pay As You Earn (PAYE) Real Time information (RTI) records from HM Revenue and Customs (HMRC), covering 1 April 2014 to 31 December 2022

We previously described the data security processes we use in our [Using the power of linked data to understand factors preventing people from working blog post](#).

All the datasets used for this analysis have been de-identified. This means no individual's attribute information can ever be directly identified from the data held by the ONS. This is because information that can be used to directly identify individuals, such as names, addresses, and NHS numbers, have been removed in a secure virtual environment before the datasets are combined and analysed.

Ethical approval for this work was provided by the [National Statistician's Data Ethics Advisory Committee](#).

Individuals' Census IDs were linked to National Insurance Number (NINo), which is the individual identifier used for HMRC records and to Department for Work and Pensions (DWP) master key, which is the individual identifier used for DWP records. Linkage was carried out using the Demographic Index, as described in our [2011 Census linkage to DWP master key and encrypted NINo methodology](#). For inclusion in the study dataset, individuals were required to have a census record in 2011 that could be linked to NHS and HMRC information.

Linkage to the Demographic Index was carried out using NHS number. Census ID was linked to the HES and death registration datasets using the Patient Register 2011 to 2013. The PAYE RTI data were calendarised to derive monthly employee pay ([gross earnings](#)), in line with the methods described in our [Monthly earnings and employment estimates from Pay As You Earn Real Time Information \(PAYE RTI\) data methodology](#). Where an individual had a Census ID linking to multiple monthly PAYE RTI records, pay was summed across all matching records for each month.

Negative monthly pay records were imputed to be zero. Monthly pay above the 99.9% centile was set to the value at the 99.9% centile. Monthly pay was deflated to 2023 prices using the Consumer Price Index including owner occupier's housing costs (CPIH). Being a paid employee was defined as receiving any amount of pay in a month.

Inclusion criteria

We constructed separate cardiometabolic multiple long-term conditions (MLTCs) cohorts for each combination and sequence of cardiovascular disease (CVD), chronic kidney disease (CKD) and diabetes. The first primary (also sometimes referred to as "underlying") recorded clinical code in Hospital Episode Statistics Admitted Patient Care (HES-APC) for CVD and CKD were identified between 1 April 2009 and 31 December 2022. For diabetes, the first primary recorded clinical code in HES-APC and Hospital Episode Statistics Outpatients (HES-OP) were identified between 1 April 2009 and 31 December 2022.

The population was further restricted to individuals aged 25 to 64 years residing in England at the time of their most recent hospitalisation (that is, index date). This ensured that the cohort comprised working-age adults and excluded those who were likely to be in education or in the process of finding employment following education.

Study population and cohort definitions

For each cardiometabolic condition, two hospitalisation flags were created based on the timing of hospital admission relative to the outcome followup period. The entire study period spanned from 1 April 2009 to 31 December 2022. However, followup for study outcomes was restricted between April 2014 and 31 December 2022, reflecting the availability of linked HMRC records. Therefore, a "current" flag was derived that identified individuals who had at least one primary diagnosis of CVD, CKD, or diabetes in Hospital Episode Statistics (HES) between 1 April 2014 and 31 December 2022.

A "prior" hospitalisation flag was created that identified individuals with a primary hospital diagnosis for the same conditions between 1 April 2009 and 31 March 2014. If an individual only had a "prior" hospitalisation flag with no "current" flag, they were excluded from our study because they were not hospitalised within our follow-up period. Where multiple qualifying admissions occurred, the earliest record was selected. When all three cardiometabolic conditions were present, the most recent condition was designated as the index condition, while the temporal order of the two preceding conditions was not considered because of sample size restrictions because of the lack of individuals with all three conditions in different sequences.

Separate cohorts and flags were derived for the subtype analysis, reflecting possible changes in cohorts compared with the main analysis, when including stroke, myocardial infarction, and heart failure as conditions of interest.

For each cohort, non-exposed groups were created to enable adjustment for time-varying confounders that would otherwise be collinear with the within-individual treatment effect among exposed individuals. For each index condition cohort, a corresponding non-exposed group was constructed comprising individuals with the same combination of preceding conditions, but without the index condition during follow-up. For example, for the cohort with CVD as the index condition and prior CKD and diabetes, the non-exposed population consisted of individuals with both CKD, and diabetes only. For the single-condition cohorts (for example, diabetes only), non-exposed individuals were sampled from a disease-free population (defined as individuals with no hospital admissions during the study period of April 2009 to December 2022).

Non-exposed individuals were then sampled using stratified random sampling by sex and five-year age band to match the age–sex distribution of the exposed group. To ensure consistency with age-based study eligibility criteria, the non-exposed group were given the same index date as that of their matched exposed participant, with individuals excluded where this criterion was not met.

Follow-up

Individuals' earnings and employment outcomes were followed up for a maximum of five years before and after hospitalisation between 1 April 2014 and 31 December 2022. Follow-up time was right-censored at the earliest of death, turning 69 years of age, or end of study period and left-censored before turning age 21 years.

Exposure and outcome definitions

The exposure in our analysis was time to, or since, first and most recent hospitalisation for a condition in each cohort, broken into six-month time periods. Hospitalisation for the most recent condition occurred in the first month of the first six-month period. The reference period, to which all time periods were compared, was condition dependent, ranging from 6 to 12 months to 24 to 30 months before hospitalisation, to account for the variation in condition progression before hospitalisation. The reference periods were defined based on where the pre-hospitalisation trends began to deviate from a period of levelling off. The time periods up to five years before hospitalisation date also enabled testing for pre-hospitalisation trends.

We analysed the effect of cardiometabolic multiple long-term conditions requiring hospital diagnosis on two outcomes:

- monthly employee earnings
- probability of being a paid employee

6 . Related links

[Impact of health conditions requiring hospitalisation on earnings, employment and benefits receipt, England: April 2014 to December 2022](#)

Article | Released 25 June 2025

The change in earnings, probability of being a paid employee and probability of benefits receipt attributable to having a major condition requiring hospital admission, compared with a reference period before the hospital admission.

[Likelihood of benefit receipt among people who are economically inactive because of long-term ill health, England and Wales: April 2020 to March 2021](#)

Statistical bulletin | Released 26 February 2025

Exploration of the socio-demographic characteristics of people who were economically inactive because of long-term ill-health at Census 2021, classified by whether they were receiving social security benefits.

[2011 Census linkage to DWP master key and encrypted NINo](#)

Methodology | Released 6 December 2024

Linkage methodology and quality information for 2011 Census linkage to DWP (Department for Work and Pensions) master key and encrypted NINo (National Insurance number).

[Using the power of linked data to understand factors preventing people from working](#)

Blog post | Released 5 December 2023

Emma Rourke explains how linked, population-level data can improve our understanding of the interplay between health and work, with the goal of improving the well-being of individuals and the economy.

7 . Cite this statistical bulletin

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