

Supplementary Material

10.1302/0301-620X.107B2.BJJ-2024-0846.R1

Data linkage details

Identifiable patient-level data for hip fracture episodes recorded between 2011 and 2016 (NHS number, date of birth, sex, and postcode) were provided to NHS Digital by the National Hip Fracture Database (NHFD) as well as a unique patient identifier (pseudonymized) for linkage. NHS Digital linked Civil Registration (deaths) date and cause of death and Hospital Episode Statistics (HES) data with the unique identifier. The University of Oxford received from NHS Digital patient-level pseudonymized data only (i.e. the linked date and cause of death and HES data with the unique patient identifier) and from NHFD patient-level pseudonymized data only (i.e. patient-level non-sensitive data with the unique patient identifier). The identifiable received by NHS Digital was then destroyed.

Definitions of hip fracture in Hospital Episode Statistics dataset

Hip fracture diagnosis (ICD-10)

- S720 Fracture of neck of femur
- S721 Pertrochanteric fracture
- S722 Subtrochanteric fracture
- S729 Fracture of femur, part unspecified

Hip fracture operation (OPCS-4)

- W241 Closed reduction of intracapsular fracture of neck of femur and fixation using nail or screw
- W461 Primary prosthetic replacement of head of femur using cement
- W471 Primary prosthetic replacement of head of femur not using cement
- W191 Primary open reduction of fracture of neck of femur and open fixation using pin and plate
- W481 Primary prosthetic replacement of head of femur NEC

Definitions of events within HES

VTE events (ICD-10)

- I26 Pulmonary embolism
- I80 Phlebitis and thrombophlebitis
- I81 Portal vein thrombosis
- I82 Other venous embolism and thrombosis

Bleeding events (ICD-10)

Upper gastrointestinal bleed

- I850 Oesophageal varices with bleeding
- K226 Gastro-oesophageal laceration-haemorrhage syndrome

K250 Gastric ulcer, acute with haemorrhage
K252 Gastric ulcer, acute with both haemorrhage and perforation
K254 Gastric ulcer, chronic or unspecified with haemorrhage
K256 Chronic or unspecified with both haemorrhage and perforation
K260 Duodenal ulcer, acute with haemorrhage
K262 Duodenal ulcer, acute with both haemorrhage and perforation
K264 Duodenal ulcer, chronic or unspecified with haemorrhage
K266 Chronic or unspecified with both haemorrhage and perforation
K270 Peptic ulcer, acute with haemorrhage
K272 Peptic ulcer, acute with both haemorrhage and perforation
K274 Peptic ulcer, chronic or unspecified with haemorrhage
K276 Chronic or unspecified with both haemorrhage and perforation
K280 Gastrojejunal ulcer, acute with haemorrhage
K282 Acute with both haemorrhage and perforation
K284 Gastrojejunal ulcer, chronic or unspecified with haemorrhage
K286 Chronic or unspecified with both haemorrhage and perforation
K290 Acute haemorrhagic gastritis
K920 Haematemesis
K921 Melaena
K922 Gastrointestinal haemorrhage, unspecified*
Lower gastrointestinal bleed
K625 Haemorrhage of anus and rectum
K922 Gastrointestinal haemorrhage, unspecified**

Respiratory bleed

R040 Epistaxis
R041 Hemorrhage from throat
R042 Hemoptysis
R048 Hemorrhage from other sites in respiratory passages
R049 Hemorrhage from respiratory passages, unspecified
J942 Haemothorax

Hematuria

R31 Haematuria***
N421 Congestion and haemorrhage of prostate

Other major bleed

R58 Haemorrhage, not elsewhere classified

Intracranial bleed

I600 Nontraumatic subarachnoid haemorrhage from carotid siphon and bifurcation
I601 Nontraumatic subarachnoid haemorrhage from middle cerebral artery
I602 Nontraumatic subarachnoid haemorrhage from anterior communicating artery
I603 Nontraumatic subarachnoid haemorrhage from posterior communicating artery
I604 Nontraumatic subarachnoid haemorrhage from basilar artery
I605 Nontraumatic subarachnoid haemorrhage from vertebral artery
I606 Nontraumatic subarachnoid haemorrhage from other intracranial arteries
I607 Nontraumatic subarachnoid haemorrhage from unspecified intracranial artery
I608 Other nontraumatic subarachnoid haemorrhage
I609 Nontraumatic subarachnoid haemorrhage, unspecified

- I610 Nontraumatic intracerebral haemorrhage in hemisphere, subcortical
- I611 Nontraumatic intracerebral haemorrhage in hemisphere, cortical
- I612 Nontraumatic intracerebral haemorrhage in hemisphere, unspecified
- I613 Nontraumatic intracerebral haemorrhage in brain stem
- I614 Nontraumatic intracerebral haemorrhage in cerebellum
- I615 Nontraumatic intracerebral haemorrhage, intraventricular
- I616 Nontraumatic intracerebral haemorrhage, multiple localized
- I618 Other nontraumatic intracerebral haemorrhage
- I619 Nontraumatic intracerebral haemorrhage, unspecified
- I620 Nontraumatic subdural haemorrhage
- I621 Nontraumatic extradural haemorrhage
- I629 Nontraumatic intracranial haemorrhage, unspecified

* with intervention/procedure associated with upper GI bleed (OPCS-4 codes G16, G42, G43, G44, G45, G55, G65, G79, G80)

** with no intervention/procedure associated with upper GI bleed

*** Only the primary diagnoses of haematuria were included.

Infection events (ICD-10)

Detail is available on application to the authors – 1333 individual ICD codes.

Acute myocardial infarction (ICD-10)

- I21 Acute myocardial infarction
- I210 Acute transmural myocardial infarction of anterior wall
- I211 Acute transmural myocardial infarction of inferior wall
- I212 Acute transmural myocardial infarction of other sites
- I213 Acute transmural myocardial infarction of unspecified site
- I214 Acute subendocardial myocardial infarction
- I219 Acute myocardial infarction, unspecified
- I22 Subsequent myocardial infarction
- I220 Subsequent myocardial infarction of anterior wall
- I221 Subsequent myocardial infarction of inferior wall
- I228 Subsequent myocardial infarction of other sites
- I229 Subsequent myocardial infarction of unspecified site

Stroke events (ICD-10)

- I61 Intracerebral haemorrhage
- I610 Intracerebral haemorrhage in hemisphere, subcortical
- I611 Intracerebral haemorrhage in hemisphere, cortical
- I612 Intracerebral haemorrhage in hemisphere, unspecified
- I613 Intracerebral haemorrhage in brain stem
- I614 Intracerebral haemorrhage in cerebellum
- I615 Intracerebral haemorrhage, intraventricular
- I616 Intracerebral haemorrhage, multiple localized
- I618 Other intracerebral haemorrhage
- I619 Intracerebral haemorrhage, unspecified
- I62 Other nontraumatic intracranial haemorrhage
- I620 Nontraumatic subdural haemorrhage
- I621 Nontraumatic extradural haemorrhage
- I629 Intracranial haemorrhage (nontraumatic), unspecified

- I63 Cerebral infarction
- I630 Cerebral infarction due to thrombosis of precerebral arteries
- I631 Cerebral infarction due to embolism of precerebral arteries
- I632 Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries
- I633 Cerebral infarction due to thrombosis of cerebral arteries
- I634 Cerebral infarction due to embolism of cerebral arteries
- I635 Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries
- I636 Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
- I638 Other cerebral infarction
- I639 Cerebral infarction, unspecified
- I64 Stroke, not specified as haemorrhage or infarction

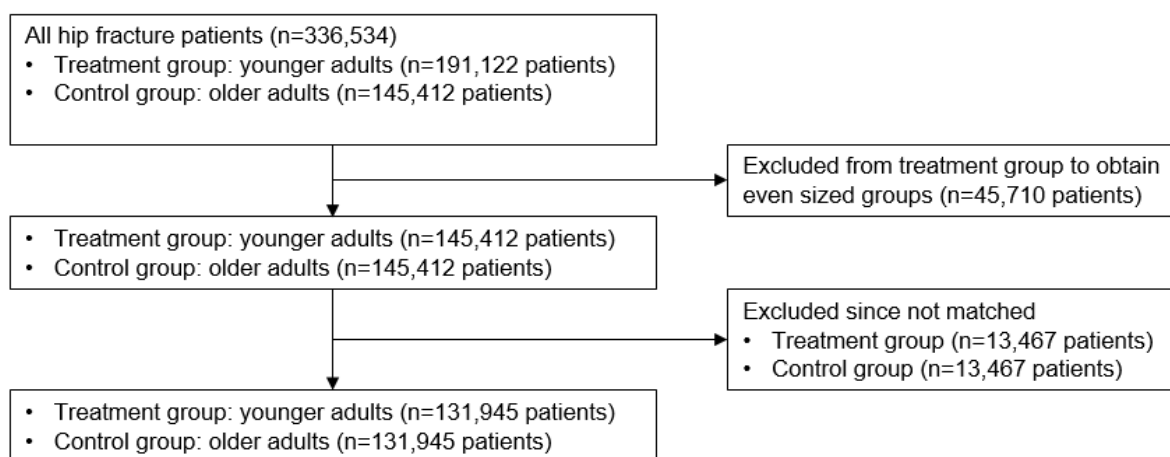
Major adverse cardiac events (ICD-10)

Defined as a hospital admission (in any diagnosis position) of acute myocardial infarction or stroke (ICD codes previously defined), or any cardiovascular-related death (in any position on the death certificate; ICD-10 codes I00-I99).

Definitions of days alive out of hospital

Days alive and out of hospital (DAOH) is a composite, patient-centred outcome that approximates time spent in good health. We calculated DAOH within 30 days, 90 days, 120 days, and 365 days after each patient’s first index hip fracture admission using the linked HES-ONS dataset (2014 to 2019) via three approaches. First, DAOH ‘unweighted’ was calculated by subtracting the number of days that a patient was in hospital (including both the index admission stay and any subsequent readmissions) or days where a patient was not alive from the total follow-up period. Second, to weight death more heavily than hospitalization, DAOH ‘weighted’ was calculated similarly to DAOH-unweighted, but patients who died during the follow up period (determined from date of death in the ONS mortality data) were attributed 0 DAOH. For instance, if a patient was discharged from hospital on day 10 after surgery but died on day 20, that patient would be assigned 10 unweighted DAOH28 and 0 weighted DAOH28. Third, DAOH ‘unweighted’ was also calculated restricted to patients who were alive by the end of follow-up period, as was termed ‘DAOH (survivors only)’.

Deriving the win ratio for a treatment effect on Days Alive out of Hospital



Using the linked HES-ONS dataset (2014 to 2019), first, using age as the ‘treatment’ variable, hip fracture patients (n = 336,534) were divided into those above (n = 145,412) and those below (n = 191,122) the median age at hip fracture in this cohort (84 years), termed younger and older adults, respectively. Second, evenly sized groups were obtained by randomly excluding patients from the

treatment (younger) group, resulting in 145,412 pairs of patients (45,710 treatment observations). Third, patients were matched 1:1 on sex and year of first hip fracture admission, resulting in 131,945 pairs of matched patients (13,467 patients in the younger group were not matched with a control, resulting in 13,467 patients excluded from each group. Fourth, the matched win ratio and win difference for the composite outcome days alive out of hospital were calculated within 28, 90, 120, and 365 days of follow-up, respectively.

Table i. Top ten most common infection-related International Classification of Diseases codes on the first infection-related episode within 28, 90, 120, or 365 days of index admission for hip fracture, 2014 to 2018.

Position	ICD-10	Description	28 days			90 days			120 days			365 days		
			n	Overall %	(n/123,924 infections) *100	n	Overall %	(n/138,726 infections) *100	n	Overall %	(n/142,655 infections)*100	n	Overall %	(n/162,697 infections) *100
1	N390	Urinary tract infection, site not specified	51,042	15.2	41.2	56,843	16.9	41.0	58,321	17.3	40.9	65,155	19.4	40.0
2	J189	Pneumonia, unspecified	21,916	6.5	17.7	23,588	7.0	17.0	23,991	7.1	16.8	26,124	7.8	16.1
3	J181	Lobar pneumonia, unspecified	20,175	6.0	16.3	22,350	6.6	16.1	22,958	6.8	16.1	26,069	7.7	16.0
4	J440	Chronic obstructive pulmonary disease with acute lower respiratory infection	15,139	4.5	12.2	16,543	4.9	11.9	16,919	5.0	11.9	18,958	5.6	11.7
5	J22	Unspecified acute lower respiratory infection	14,148	4.2	11.4	15,649	4.7	11.3	16,051	4.8	11.3	18,311	5.4	11.3
6	B962	<i>Escherichia coli</i> (<i>E. coli</i>) as the cause of diseases classified to other chapters	13,632	4.1	11.0	14,796	4.4	10.7	15,081	4.5	10.6	16,341	4.9	10.0
7	A419	Sepsis, unspecified	7,047	2.1	5.7	8,295	2.5	6.0	8,637	2.6	6.1	10,454	3.1	6.4
8	L031	Cellulitis of other parts of limb	5,419	1.6	4.4	6,439	1.9	4.6	6,723	2.0	4.7	8,067	2.4	5.0
9	B968	Other specified bacterial agents as the cause of diseases classified to other chapters	4,040	1.2	3.3	4,501	1.3	3.2	4,624	1.4	3.2	5,078	1.5	3.1
10	T814	Infection following a procedure, not elsewhere classified	3,913	1.2	3.2	4,305	1.3	3.1	4,355	1.3	3.1	4,575	1.4	2.8