Variation in the quality of hip fracture care by day and time of presentation: a nationwide prospective cohort study from the National Hip Fracture Database for England, Wales and Northern Ireland

ABSTRACT

OBJECTIVE

To describe how the quality of care offered to patients with hip fracture varies with the day and day of their presentation.

DESIGN

Population-based cohort study using the National Hip Fracture Database (NHFD).

SETTING

All hospitals in England, Wales and Northern Ireland.

PARTICIPANTS

Patients aged 60 years and over with a hip fracture in 2017.

MAIN OUTCOME MEASURES

Provision of prompt surgery (surgery within 36 hours of presentation) was examined, using multivariable logistic regression with generalized estimating equations to derive adjusted risk ratios (RR) for 21 eight-hour time periods across the week.

RESULTS

We studied 68,977 patients from 177 hospitals. Patients presenting on Fridays and Saturdays during 16:00-23:59 were significantly less likely to receive prompt surgery compared with patients presenting on other days (Friday during 16:00-23:59 risk ratio (RR)=0.83, 95% CI=0.80-0.85; Saturday during 16:00-23:59 RR=0.81, CI=0.78-0.85). Patients presenting overnight between 00:00-07:59, except on Saturdays, were significantly more likely to receive surgery within 36 hours (RR>1.07).

CONCLUSIONS

The provision of prompt hip fracture surgery variation was complex, with evidence of both an "evening" and a "weekend" effect. Investigation of weekly variation in hip fracture care is required to help implement strategies to reduce the variation in care quality throughout the entire week.

Introduction

Numerous studies of the "weekend effect" have suggested that patients receive poorer quality care and may have worse outcomes if they are admitted at weekends and/or outside routine working hours.[1-5] These studies have led to substantial changes in how weekend healthcare is delivered,[6,7] though this may be premature given the lack of understanding about why weekend admission might have poorer outcomes.[8]

Work describing a nationwide registry study of acute stroke patients observed complex variation in the quality of care provided across the week, suggesting that the "weekend effect" is an oversimplification of the true problem.[9] A key issue is that for many conditions the patients who present as emergencies at the weekend may be very different from those who are able to wait, or who are admitted semi-electively during the week.

Hip fracture avoids this problem and is an ideal condition with which to examine the "weekend effect". It is common; an incidence of around one in a thousand means that 70,000 people present in the United Kingdom each year, at a cost to National Health Service and social care of over £1 billion.[10,11] Patients require emergency hospital admission for trauma, almost all receive surgery within a few days, and mortality is substantial within a frail and elderly group of people.

The national clinical audit of hip fractures was established in England and Wales in 2007 with the aim of improving outcomes. The programme included a National Hip Fracture Database (NHFD) in England, Wales and Northern Ireland, which promotes high quality care as defined in national guidance.[12] In 2010, the NHFD was the basis for a pay-for-performance initiative,

called the 'Best Practice Tariff' (BPT). The BPT scheme pays hospitals a supplement of £1,335 per patient whose care satisfied six clinical standards, such as surgery within 36 hours of presentation, as this is known to improve outcome.[12,14-16] The success of this means that this national clinical audit has presided over a reduction in 30-day mortality for hip fracture patients from 10.9% when it was established in 2007, to just 6.1% in 2016.[10,17,18] This is despite patient case-mix getting progressively worse over time.

We used NHFD data to define how patients' chances of receiving prompt hip fracture surgery varied across the hours of the day and days of the week.

Methods

Study design and data sources

We performed an analysis of prospectively collected NHFD data. The NHFD was established in 2007 and captures more than 97% of all hip fractures in people aged 60 years and above, in England, Wales and Northern Ireland.[10] Data are collected on patient characteristics including the type of fracture, the surgery performed, details of the care they receive, and outcomes which include 30-day mortality. These data are collected by the staff who provide care to hip fracture patients locally and are used to assess each hospital's performance against established evidence-based quality performance indicators, including time from first presentation to operation (surgery within 36 hours).

Participants and procedures

We studied an anonymised extract of data for all 70,573 patients who presented at one of 177 hospitals in England, Wales and Northern Ireland between 1st January 2017 and 31st December 2017. The NHFD collects precise data on their operation. Only a very small number of patients were excluded as their date and time of their presentation (n=6) or of their operation were not available (n=1,590).

The primary exposure of interest is the day and time of patient presentation. A number of key performance indicators have been defined for hip fracture[11] but in this study the outcome of interest was whether a patient received prompt hip fracture surgery (an operation starting within 36 hours of presentation). This is an important indicator of care quality derived from national guidelines, against which hospitals are formally assessed.[12,13]

Covariates chosen a-priori to control for as potential confounding factors[19] included: patient age; sex; location from which the patient was admitted ('own home or sheltered housing' or 'not their own home'); pre-injury mobility ('freely mobile without aids', 'mobile outdoors with 1 aid or 2 aids or 1 frame' and 'some indoor mobility or no functional mobility'); fracture type (intracapsular, intertrochanteric, and subtrochanteric); type of surgery performed; and American Society of Anaesthesiologists (ASA) grade. The ASA grade ranges from 1 (healthy patient) to 5 (moribund patient not expected to live for more than 24 hours with or without surgery).[20]

The type of hip fracture that a patient has will influence the type of surgery that they receive such as a partial or total hip replacements, or fixation with plates screws and rods. This may influence time to surgery based on availability of suitably experienced hip surgeons to

perform different types of operations. Although fracture type and type of surgery are associated with each other, the association is not strong enough to lead to collinearity. There is variation between surgeons and units such that all types of operations have been used for all types of fractures, even if some of these are in smaller numbers.

Statistical analysis

Descriptive statistics were used to summarise the epidemiology of hip fractures by day and time of presentation, and relevant patient and surgical factors.

Analyses were performed according to the day and time of patient presentation. The effect of time on the outcome of 'receiving surgery within 36 hours' was found to be non-linear. Hence, we were not able to treat time as a continuous variable in the model. Time was categorised into 3 eight-hour intervals (08:00-15:59, 16:00-23:59 and 00:00-07:59,) for each day of the week. This provided 21 different categories over the whole week. These time periods were chosen based on clinical relevance relating to when patients present and receive surgery.

A generalised linear model was used to assess the effect of the 21 eight-hour periods of the week, and the other covariates (described above) on the risk of patients receiving surgery within 36 hours of admission. All predictors were assessed in univariable models, and then an analysis was conducted using a generalised linear model with a binomial error structure and log link function (log-logistic model) in order to estimate the relative risk ratio and risk difference using an identity link function. The model accounted for clustering by hospital with

generalised estimating equations (GEE) using a population average approach.[21] All analyses were conducted using Stata Version 14.2 (StataCorp LLC, College Station, Texas).

Patient and public involvement

Patients and members of the public were not directly involved in the design of this research project, but a Patient Panel managed by the Royal Osteoporosis Society advises on the approach taken by the NHFD and other projects within the Falls and Fragility Fracture Audit Programme at the Royal College of Physicians.

Results

There were 68,977 hip fracture patients eligible for inclusion (Table 1). The mean age was 82.7 (range 60 to 109) years, and 48,798 (71%) were women. The percentage of patients presenting each day nationally was similar (14% or 15% each day) during Monday to Saturday, but slightly fewer were admitted on a Sunday (13%). Most presented during the day (42% during 08:00-15:59 and 41% during 16:00-23:59), with the remainder admitted overnight (16% during 00:00-07:59).

The mean time between presentation and surgery was 34.0 (SD=41.6) hours (Table 1). The median was 24.4 hours, the 25th centile was 18.6, the 75th centile was 40.3, the 90th centile was 60 and the 95th centile was 160.1. Overall, 70% (n=48,441) of all patients received surgery within 36 hours. The overall percentage of patients receiving prompt surgery nationally ranged from 60% to 80% depending on the specific day and time of the week. Fewer patients received prompt surgery if they presented on a Friday (67%) or Saturday (65%) compared with other days of the week (72%). Fewer patients received prompt surgery if they presented

in the evening between 16:00-23:59 (66%) compared with being admitted during the day between 08:00-15:59 (71%) or overnight between 00:00-07:59 (78%).

A generalised linear model, which accounted for clustering by hospital, involving all covariates based on 67,048 hip fractures with complete data available demonstrated that both day and time of presentation affected the time to surgery (Table 2). Patients presenting on Fridays and Saturdays during 16:00-23:59 were significantly less likely to receive prompt surgery compared with patients presenting at other days and times (Friday during 16:00-23:59 risk ratio (RR)=0.83, 95% CI=0.80-0.85; Saturday during 16:00-23:59 RR=0.81, CI=0.78-0.85). In absolute terms, this is equivalent to a risk difference of approximately 13-14% compared to Thursday daytime (Friday during 16:00-23:59 risk difference (RD)=-0.132, 95% CI=-0.15- -0.11; Saturday during 16:00-23:59 RD=-0.141, CI=-0.17- -0.11). The number needed to treat is eight, which means that one additional person does not receive prompt surgery for every eight patients that present on Friday or Saturday evening. Patients presenting overnight between 00:00-07:59, except on Saturdays, were significantly more likely to receive surgery within 36 hours (RR>1.07).

Factors associated with a lower likelihood of prompt surgery were male sex, age under 80 years, ASA grades 4 and 5, patients who were not freely mobile without aids, and those undergoing total hip replacement (Table 2).

Discussion

There were complex patterns in healthcare quality across the week, with evidence of both an "evening effect" (16:00-23:59) and "weekend effect" (Friday and Saturday) on performance.

The reasons for this temporal variation are likely to be multifactorial and our findings suggest that current attempts to increase weekend services and staffing will not fully address variation in quality of healthcare for hip fracture patients.

Our confirmation of this temporal variation in care quality at a national level, would suggest that care quality in other acute medical and surgical conditions should be investigated in a similar fashion.

We also observed other factors which influenced this care quality indicator. Patients were less likely to receive hip fracture surgery within 36 hours of presentation if they were sicker (ASA grades 4 and 5) and frailer (not freely mobile without aids). This is not unsurprising as such patients often need more pre-operative care and optimisation before they are considered suitable to undergo major surgery. Total hip replacement is generally performed in younger patients with intracapsular fractures and is offered as an alternative to hemiarthroplasty.[22] However, this is more technically demanding to perform than the other types of hip fracture surgery, and as such there have been substantial variations in its use across the country in eligible patients.[23] When total hip replacement is offered, the requirement of appropriate surgical expertise can result in delays before performing surgery. Therefore, this may explain our findings that both age under 80 years and patients undergoing total hip replacement were less likely to receive timely surgery.

<u>Strengths and weaknesses</u>

This study includes nearly every patient presenting with hip fracture in England, Wales, and Northern Ireland. We have used analytical methods to model temporal variation in healthcare quality in hip fracture patients by the day and time of the week that accounted for clustering by hospital. Since the NHFD was designed to capture relevant covariates for the hip fracture population, we were able to make appropriate adjustments in these analyses.

Time to theatre is a key indicator of care quality for hip fracture surgery, but individual hospitals may perform differently for other indicators of care quality, such as prompt post-operative mobilisation. Future work will explore these other indicators. Missing data for some variables may have influenced the findings, but the proportion of missing data were small (2% or less). Our statistical models were adjusted for important covariates relevant to the hip fracture population, but we were unable to adjust for other potentially important variables (like specific medical comorbidities) or unknown confounders.

Comparison with other studies

Many studies have suggested that patients admitted at weekends and/or outside of routine working hours receive poorer quality healthcare.[1-5,24-27] However, these analyses have often simplified the problem by directly comparing weekday with weekend care, or normal working hours with out-of-hours. This makes comparison and interpretation of the literature difficult. Studies with more sophisticated methodology have demonstrated temporal patterns of care quality across both the day of the week and time in acute stroke patients,[9] all hospital inpatients,[28] and in obstetrics.[29]

Hip fracture care is a better test of the weekend effect since similar patients will present across the week, unlike other conditions for which patients may be admitted semi-electively or for investigation during the working week, and only as an emergency at the weekend.

Studies have shown that compared with weekday admissions, patients presenting with hip fracture at weekends have higher mortality[30] and longer delays to surgery.[31] Furthermore, there is evidence of increased mortality in hip fracture patients having surgery on a Sunday.[15] A study from the Netherlands found no weekend effect in outcomes when simply comparing patients presenting during the week with those presenting at the weekend.[32] However to our knowledge there are no studies assessing the temporal variation in this care quality indicator across both the day and time of the week.

The “evening effect” and “weekend effect” on care quality observed in our study was similar to that previously reported in the acute stroke population, with patients admitted overnight and at the weekend less likely to receive timely thrombolysis.[9] Like thrombolysis, receiving hip fracture surgery in a timely fashion is a complex process relying on many steps in the care pathway to occur swiftly and effectively. These include initial assessment, diagnostic imaging, pre-operative optimisation, and operating theatre capacity and staff availability. Poorer provision of prompt surgery for patients who present in the evening or at weekends is likely to be related to problems with at least one of these milestones. Individual “heat maps” for each hospital have been published by NHFD on its website (www.nhfd.co.uk), which will allow local teams to understand where they are failing to provide a prompt and coordinated response. The presence of key decision makers, may have the greatest potential for correcting weaknesses at certain times during the week.[9]

Given the complex nature of hip fracture patients, it is recommended their management is coordinated by senior experts using a multidisciplinary approach, including orthopaedic surgeons, orthogeriatricians, and anaesthetists.[10,12] Availability of key professionals may be reduced at weekends and overnight, and may contribute to poorer quality healthcare for hip fracture patients during these times.

Potential explanations for delays in patients receiving hip fracture surgery also relate to theatre capacity and efficiency. The NHFD audits reasons for surgical delays, and in 2017 they reported that although surgical delays for clinical reasons (e.g. needing medical investigation and optimisation) remained stable compared with previous years, delays due to lack of capacity on theatre lists and list over-runs have increased from 13.2% in 2016 to 14.4% in 2017.[10] This is compounded by frequent reports of theatre lists routinely starting late, avoidable cancellation of individual patients, and 61% of hospitals not having a dedicated hip fracture operating list, meaning such cases would need to be rationed with other trauma operations and/or other surgical emergencies.[10,23] Financial incentives may also influence time to theatre, as hospitals do not receive the Best Practice Tariff if surgery is performed after 36 hours. This includes all hospitals in Wales and Northern Ireland who are not offered this financial incentive. Therefore, new hip fracture admissions may be prioritised for theatre over patients who have already waited more than 36 hours.

The NHFD annual report 2019 has shown there is substantial variation observed in time to hip fracture surgery between hospitals, ranging from 14% and 95%[33]. Our study and the work of

the NHFD clearly demonstrate that many hospitals are delivering good quality hip fracture care throughout the week. Important lessons can be learnt from better performing hospitals.

The entire pathway from admission to surgery should be scrutinised and include emergency department care, pre-operative assessment and optimisation, and logistics around operating theatre capacity; as well as understanding the number and expertise of the multi-disciplinary healthcare team involved in the care of patients throughout the entire week.

Aside from the direct performance financial incentive to perform timely surgery described earlier, it is clear theatre capacity and efficiency is becoming increasingly problematic.[10] Suggestions to improve this include dedicated daily hip fracture lists, extra daytime lists and/or lists with extended hours and formally categorising hip fracture as an emergency when competing with other specialties for space on emergency theatre lists. It is currently recommended that hip fracture surgery occurs during normal working hours by senior experienced staff.[34] However, the evidence of higher mortality with delayed surgery,[14-16] coupled with the increasing problems with patient demand versus theatre capacity, means that hospitals need to examine their dedicated trauma theatre capacity and, if required, increase sessional availability into evenings and across weekends.

Meaning of the study

There are complex temporal variations in the quality of care provided to hip fracture patients on a national level. The variation highlights there are many opportunities available at all levels (local, regional, and national) to substantially improve the delivery and quality of care for hip fracture patients.

Unanswered questions and future research

We recommend urgent investigation of this variation in hip fracture care to help implement strategies to reduce the variation in care quality thought the entire week. We suggest that focussing only on improving care quality at the weekend will not fully address the problems in health care quality during the entire week. We recommend that similar analyses are performed to assess the temporal variation in care quality for other acute medical and surgical conditions.

WHAT IS ALREADY KNOWN ON THIS TOPIC

In hip fracture patients, many studies have assessed and demonstrated that prompt surgery (within 36 hours or less from presentation) significantly reduces patient mortality.

The evidence regarding a true “weekend effect” in mortality following hip fracture surgery is contentious. Temporal variation has been investigated in this manner in other patient cohorts, including obstetrics and all hospital inpatients.

A recent study in acute stroke patients observed that care quality varied across the whole week, and suggested that the “weekend effect” was only one of several patterns of variation in quality that occur in clinical practice.

WHAT THIS STUDY ADDS

We have demonstrated that the patterns in variation of healthcare quality in hip fracture patients were complex throughout the week, with evidence of both an “evening effect” and a “weekend effect”.

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Table 1: Baseline characteristics of fragility hip fracture patients treated in England, Wales and Northern Ireland during 2017, as recorded in the National Hip Fracture Database

Variables		All participants	
		Number	%
		68,977	100
Fracture type	Intracapsular	40,218	58
	Intertrochanteric	24,652	36
	Subtrochanteric	3,990	6
	Missing	117	<1
Day and time of presentation	Monday 0800-1559	4,146	6
	Monday 1600-2359	4,159	6
	Monday 0000-0759	1,553	2
	Tuesday 0800-1559	4,464	6
	Tuesday 1600-2359	4,116	6
	Tuesday 0000-0759	1,631	2
	Wednesday 0800-1559	4,344	6
	Wednesday 1600-2359	4,194	6
	Wednesday 0000-0759	1,478	2
	Thursday 0800-1559	4,481	7
	Thursday 1600-2359	4,320	6
	Thursday 0000-0759	1,646	2
	Friday 0800-1559	4,327	6
	Friday 1600-2359	4,147	6
	Friday 0000-0759	1,559	2
	Saturday 0800-1559	3,804	6
	Saturday 1600-2359	3,910	6
	Saturday 0000-0759	1,628	2
	Sunday 0800-1559	3,671	5
	Sunday 1600-2359	3,740	5
	Sunday 0000-0759	1,659	2
Operation type	Hemiarthroplasty	30,221	44

	Total Hip Replacement	5,424	8
	Internal fixation - cannulated screws	2,003	3
	Internal fixation - intramedullary nail	9,409	14
	Internal fixation - sliding hip screw	21,740	32
	Other / missing	180	<1
Sex	Female	48,798	71
	Male	20,179	29
Age groups	60-69 years	6,243	9
	70-79 years	15,879	23
	80-89 years	31,201	45
	90+ years	15,654	23
Admitted from	Own home/sheltered housing	56,331	82
	Not from own home	12,584	18
	Missing	62	<1
ASA grade	ASA grade 1 or 2	17,230	25
	ASA grade 3	39,214	57
	ASA grade 4 or 5	11,383	17
	Missing	1,150	2
Preinjury mobility	Freely mobile without aids	24,927	36
	Mobile outdoors with 1 aid or 2 aids or 1 frame	25,654	37

	Some indoor or no functional mobility	17,651	26
	Missing	745	1
Mean time to surgery (hours)		34.0	
Time to surgery	Less than 36 hours	48,441	70
	More than 36 hours	20,536	30

Table 2: The odds of patients receiving surgery within 36 hours of presentation with a fragility hip fracture during 2017 in England, Wales and Northern Ireland, as recorded in the National Hip Fracture Database

Variables				Univariate models		Multivariable model with clustering by hospital -GEE (n=67,048)			
		Number	%						
		68,977	100	Risk ratio (95% CI)	P value	Risk ratio (95% CI)	P value	Risk difference (95% CI)	P value
Fracture type	Intracapsular	40,218	58	1.00		1.00		0	
	Intertrochanteric	24,652	36	1.07 (1.06-1.08)	<0.001	1.03 (1.01-1.06)	0.004	0.024 (0.01-0.04)	0.005
	Subtrochanteric	3,990	6	1.01 (0.98-1.03)	0.566	1.01 (1.01-1.06)	0.605	0.005 (-0.02—0.03)	0.658
Day and time of presentation	Monday 08:00-15:59	4,146	6	1.00 (0.97-1.04)	0.771	1.01 (0.98-1.04)	0.662	0.003 (-0.02-0.03)	0.770
	Monday 16:00-23:59	4,159	6	0.93 (0.91-0.96)	<0.001	0.94 (0.91-0.96)	<0.001	-0.047 (-0.07- -0.03)	<0.001
	Monday 00:00-07:59	1,553	2	1.07	<0.001	1.07	<0.001	0.053	<0.001

				(1.04-1.10)		(1.04-1.11)		(0.03-0.08)	
	Tuesday 08:00-15:59	4,464	6	1.00 (0.97-1.02)	0.724	1.00 (0.98-1.03)	0.918	0.002 (-0.02-0.02)	0.879
	Tuesday 16:00-23:59	4,116	6	0.93 (0.90-0.95)	<0.001	0.93 (0.90-0.95)	<0.001	-0.052 (-0.07- -0.03)	<0.001
	Tuesday 00:00-07:59	1,631	2	1.09 (1.06-1.13)	<0.001	1.10 (1.07-1.14)	<0.001	0.075 (0.05-0.10)	<0.001
	Wednesday 08:00-15:59	4,344	6	0.99 (0.97-1.02)	0.656	1.00 (0.98-1.02)	1.000	0.000 (-0.02-0.02)	0.968
	Wednesday 16:00-23:59	4,194	6	0.93 (0.90-0.96)	<0.001	0.93 (0.91-0.96)	<0.001	-0.050 (-0.07- -0.03)	<0.001
	Wednesday 00:00-07:59	1,478	2	1.08 (1.05-1.11)	<0.001	1.08 (1.05-1.12)	<0.001	0.062 (0.04-0.09)	<0.001
	Thursday 08:00-15:59	4,481	7	1.00				0	
	Thursday 16:00-23:59	4,320	6	0.93 (0.90-0.95)	<0.001	0.93 (0.90-0.96)	<0.001	-0.051 (-0.07- -0.03)	<0.001
	Thursday 00:00-07:59	1,646	2	1.09 (1.06-1.13)	<0.001	1.10 (1.07-1.13)	<0.001	0.075 (0.05-0.10)	<0.001
	Friday 08:00-15:59	4,327	6	0.94 (0.91-0.96)	<0.001	0.93 (0.91-0.96)	<0.001	-0.054 (-0.08- -0.03)	<0.001
	Friday 16:00-23:59	4,147	6	0.83 (0.80-0.86)	<0.001	0.83 (0.80-0.85)	<0.001	-0.132 (-0.15- -0.11)	<0.001
	Friday 00:00-07:59	1,559	2	1.07 (1.03-1.11)	<0.001	1.07 (1.03-1.10)	<0.001	0.052 (0.03-0.08)	<0.001
	Saturday 08:00-15:59	3,804	6	0.91 (0.88-0.94)	<0.001	0.91 (0.88-0.94)	<0.001	-0.074 (-0.10- -0.05)	<0.001
	Saturday 16:00-23:59	3,910	6	0.82 (0.78-0.85)	<0.001	0.81 (0.78-0.85)	<0.001	-0.141 (-0.17- -0.11)	<0.001
	Saturday 00:00-07:59	1,628	2	0.98 (0.94-1.02)	0.370	0.98 (0.94-1.02)	0.296	-0.019 (-0.05-0.01)	0.238

	Sunday 08:00-15:59	3,671	5	0.99 (0.96-1.02)	0.628	0.99 (0.96-1.02)	0.493	-0.010 (-0.03-0.01)	0.376
	Sunday 16:00-23:59	3,740	5	0.94 (0.92-0.97)	<0.001	0.94 (0.92-0.97)	<0.001	-0.044 (-0.06- -0.02)	<0.001
	Sunday 00:00-07:59	1,659	2	1.04 (1.01-1.07)	0.024	1.03 (1.00-1.07)	0.042	0.025 (0.00-0.05)	0.054
Operation type	Hemiarthroplasty	30,221	44	1.00		1.00		0	
	Total hip replacement	5,424	8	0.87 (0.85-0.90)	<0.001	0.83 (0.80-0.86)	<0.001	-0.132 (-0.15- -0.11)	<0.001
	Internal fixation - cannulated screws	2,003	3	1.01 (0.98-1.05)	0.395	0.99 (0.96—1.02)	0.411	-0.011 (-0.03-0.01)	0.39
	Internal fixation - intramedullary nail	9,409	14	1.01 (0.99-1.02)	0.372	0.98 (0.95-1.01)	0.113	-0.017 (-0.04-0.00)	0.095
	Internal fixation - sliding hip screw	21,740	32	1.06 (1.05-1.08)	<0.001	1.02 (1.00-1.05)	0.085	0.017 (0.00-0.04)	0.069
	Other / missing	180	0	0.82 (0.71-0.94)	0.006	0.80 (0.70-0.92)	0.001	-0.139 (-0.22- -0.06)	<0.001
Sex	Female	48,798	71	1.00		1.00		0	
	Male	20,179	29	0.95 (0.94-0.96)	<0.001	0.96 (0.95-0.97)	<0.001	-0.028 (-0.03- -0.02)	<0.001
Age groups	60-69 years	6,243	9	0.97 (0.95-0.99)	0.004	0.98 (0.96-1.00)	0.119	-0.017 (-0.03-0.00)	0.016
	70-79 years	15,879	23	0.98 (0.97-0.99)	<0.001	0.98 (0.97-1.00)	0.007	-0.013 (-0.02-0.00)	0.005

	80-89 years	31,201	45	1.00		1.00		0	
	90+ years	15,654	23	1.03 (1.01-1.04)	<0.001	1.02 (1.01-1.04)	<0.001	0.017 (0.01-0.03)	
Admitted from	Own home/sheltered housing	56,331	82	1.00		1.00		0	
	Not from own home	12,584	18	1.05 (1.04-1.06)	<0.001	1.07 (1.05-1.08)	<0.001	0.049 (0.04-0.06)	<0.001
ASA grade	ASA grade 1 or 2	17,230	25	1.05 (1.04-1.07)	<0.001	1.10 (1.09-1.11)	<0.001	0.071 (0.06-0.08)	<0.001
	ASA grade 3	39,214	57	1.00		1.00		0	
	ASA grade 4 or 5	11,383	17	0.86 (0.84-0.88)	<0.001	0.84 (0.83-0.86)	<0.001	-0.117 (-0.13- -0.11)	<0.001
Preinjury mobility	Freely mobile without aids	24,927	36	1.00		1.00		0	
	Mobile outdoors with 1 aid or 2 aids or 1 frame	25,654	37	0.98 (0.97-1.00)	0.007	0.98 (0.97-0.99)	<0.001	-0.017 (-0.02- -0.01)	<0.001
	Some indoor or no functional mobility	17,651	26	0.99 (0.98-1.01)	0.261	0.98 (0.96-0.99)	0.005	-0.016 (-0.03-0.00)	0.006

Funding: This work was performed to provide individual hospitals participating in the NHFD with a picture of variation in their performance across the week, as part of a Royal College of Physicians audit programme commissioned by the HealthCare Quality Improvement Partnership (HQIP). The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the NHS or the Department of Health. The funding source had no role in the design and conduct of the study, in the collection, analysis and interpretation of the data, or in the preparation, review or approval of the manuscript. The corresponding author had full access to all the study data and had final responsibility for the decision to submit for publication.

Ethical approval: Research ethics committee approval was not required for secondary analysis of administrative data in line with Governance Arrangements for Research Ethics Committee (GAfREC) guidance.

Data sharing: The study is based on data from the National Hip Fracture Database and was provided within the terms of an NHS Digital sharing agreement. The data do not belong to the authors and may not be shared by the authors, except in aggregate form for publication. Data can be obtained by submitting a research request through the NHS Digital Data Access Request Service.

Transparency: The guarantor affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.