

# Clinical Characteristics and Mortality of Old and Very Old Patients Hospitalized for Hip Fracture or Acute Medical Conditions

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## Abstract

**BACKGROUND:** There is increasing interest in healthcare quality and economic implications for hip fracture patients of very old age. However, results are limited by access to comparable control groups.

**OBJECTIVES:** We examined healthcare quality measures including mortality and length of stay (LOS) in hospital of adults aged 60-107 years undergoing hip operations, compared to an age-matched group admitted for acute general medical conditions.

**DESIGN:** Monocentric cross-sectional study.

**SETTING:** Ashford and St Peter's Hospitals NHS Foundation Trust, Surrey, United Kingdom.

**PARTICIPANTS:** A total of 3972 consecutive admissions for hip operation from 1st April 2009 to 30th June 2019 (dataset-1) and 6979 for acute general medical conditions from 1st April 2019 to 29th February 2020 (dataset-2). Respective ages, mean ( $\pm$ standard deviation), were 83.5 years ( $\pm$ 9.1) and 79.8 years ( $\pm$ 9.8).

**MEASUREMENTS:** Mortality and LOS were assessed with each group divided into five-year age bands and those  $\geq$ 95 years.

**RESULTS:** There were proportionally more ( $P < 0.001$ ) females admitted for hip operations (72.8%) than for acute general medical conditions (53.8%). Amongst patients admitted with general medical conditions, the frequency of the most serious recorded conditions - including congestive heart failure, stroke, and pneumonia - increased with age. Amongst patients undergoing hip operations, 5.7% died in hospital and 29.3% had a LOS  $\geq$ 3 weeks. Corresponding values for acute general medical conditions were 10.4% and 11.8%. For those undergoing hip operations in all age categories, the risk of death was lower than for acute general medical group: sex-adjusted odds ratios ranged between 0.27 and 0.67, but the risk of LOS  $\geq$ 3 weeks was greater: odds ratios ranged between 2.46 and 2.95.

**CONCLUSIONS:** Compared to those admitted with acute general medical conditions, patients admitted for hip operations had a lower risk of death, but a longer hospital LOS.

*Key words:* Geriatrics, health economics, discharge planning, healthcare quality.

## Introduction

In high income countries the population age profile in favour of older adults has been changing over the past five decades. In the UK, the greatest increase is in those

over 85 years. In 2016, there were 1.6 million people aged above 85 years (2% of the total population); by 2041 this is projected to reach 3.2 million, rising further to 5.1 million by 2066 (7% of the total population) (1). Older age is associated with greater overall frailty and frequent falls and one of the biggest causes of hospital admissions in the older adult is from hip fractures due to falls. Because of this rising incidence, in both sexes (2), there are currently more people than ever living with the consequences of a hip fracture (3, 4). This life-changing event can result in disability requiring a high level of care, including a lengthy stay in hospital; as well as premature death, including before hospital discharge (5-8).

There is an increasing interest in the impact of hip fractures on an ageing population of patients, particularly those older than 90 years of age, and the implications for improving care with disability, survival and consequences for health economics (9-13). Hitherto, results from previous studies have been limited due to the smaller number of very old patients, so that these studies accumulated data from different centres where management procedures may differ (13). More crucially, younger patients have been used as control groups where comparisons may be inappropriate (9, 10, 14). In this study, indicators of care-quality, including in-hospital length of stay (LOS) and mortality, were compared between patients admitted for hip operations and those admitted with acute general medical conditions. An age-stratified analysis was used to include examination of very old age ( $\geq$ 90 years) patients who were admitted to a single National Health Service (NHS) hospital.

## Methods

### *Study design, participants and setting*

This a cross-sectional study of older ( $\geq$ 60 years) patients admitted to Ashford and St Peter's Hospitals NHS Foundation Trust, Surrey, United Kingdom, comprising two datasets. Dataset-1 contains 3972 consecutive admissions between 1st April 2009 and 30th June 2019 for hip fracture operations, and dataset-2 contains 6979 patients admitted between 1st April 2019 and 29th February 2020 with acute general medical

**Table 1.** Distribution of patients admitted for hip operation and those admitted with acute general medical conditions

Age (years)	Dataset 1: Hip operations (1st April 2009 to 30th June 2019)		Dataset 2: Acute general medical conditions (1st April 2019 to 29th February 2020)	
	n	%	n	%
60-64.9	163	4.1	631	9.0
65-69.9	180	4.5	670	9.6
70-74.9	270	6.8	978	14.0
75-79.9	524	13.2	1063	15.2
80-84.9	872	22.0	1260	18.1
85-89.9	1000	25.2	1241	17.8
90-94.9	697	17.5	777	11.1
≥95*	229	6.7	318	5.1
All patients	3972	100	6979	100

\*Maximum age = 107 years, including 37 centenarians in dataset 1, and 41 centenarians in dataset 2.

conditions. The two datasets were compared for LOS and mortality.

Data for every patient admitted with a hip fracture were collected through our participation in the National Hip Fracture Database (15, 16). Data for all unplanned admissions with acute general medical conditions were collected in accordance with NHS guidelines, and were recorded by the Patient Administration System (17, 18). For the purpose of this study, only adults admitted with acute general medical conditions aged ≥60 years were included to match those admitted for a hip operations.

### Categorisation of data

Prolonged LOS was defined as hospitalization of ≥3 weeks. Age categories were created for every five-year age band from 60 years, except all those aged ≥95 years were considered as one category due to their relatively small number.

### Statistical analysis

Differences between categorical outcome variables were assessed by  $\chi^2$ -tests. Differences in LOS between two groups and between multiple sub-groups were assessed by Mann-Whitney U tests and by Kruskal-Wallis tests, respectively. Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI) of outcome measures between patients undergoing hip operations and those admitted with acute general medical conditions (reference group). The results are presented from two models; model 1 – unadjusted; model 2 - adjusted for sex. Analyses were conducted using IBM SPSS Statistics, v25.0 (IBM Corp., Armonk, NY).

## Results

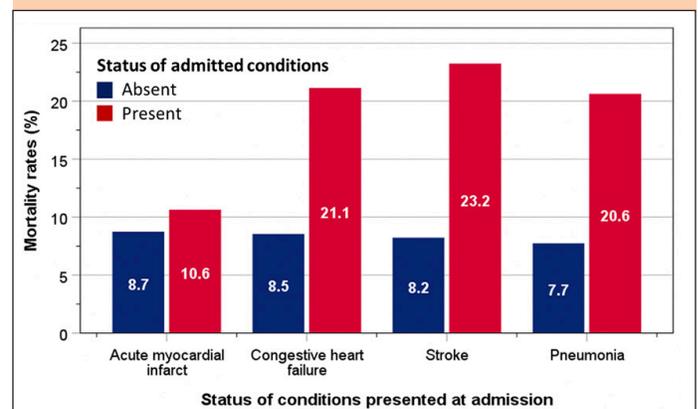
### General characteristics

The mean ( $\pm$ SD) ages of the two groups were not significantly different ( $P > 0.05$ ) and were: 83.5 years ( $\pm 9.1$ ) for those requiring hip operations and 79.8 years ( $\pm 9.8$ ) for those with acute general medical conditions. Amongst patients undergoing a hip operation, there were 5.7% who died and

29.3% had a LOS ≥3 weeks in hospital; the corresponding values for those admitted with acute general medical conditions were 10.4% and 11.8%.

However, the age profiles of the two groups were different; there were greater percentages in the four highest age groups (i.e. those ≥80 years of age) for those requiring hip operations compared to those in the acute general medical conditions cohort (Table 1). In particular, 37 patients undergoing hip operations were over 100 years of age (0.9% of the total) as were 41 patients admitted with acute medical conditions (0.6% of the total). There were proportionally more ( $P < 0.001$ ) females admitted for hip operations (72.8%) than for acute general medical conditions (53.8%).

Amongst patients admitted with general medical conditions, the frequency of the most serious recorded conditions - including congestive heart failure, stroke, and pneumonia - increased with age, except for acute myocardial infarction, which decreased with age (Table 2). These conditions were associated with higher rates of mortality in this study group (Figure 1).

**Figure 1.** Mortality rates in relation to conditions presented at admission in the acute general medical conditions group

### Comparison of in-hospital mortality

Rates of in-hospital mortality were consistently lower within each age band amongst patients who were admitted for hip

**Table 2.** Age-dependent proportions of serious diagnoses in 6979 patients admitted with acute general medical conditions

Age (years)	Acute myocardial infarct	Congestive heart failure	Stroke	Pneumonia
60-64.9	6.7	1.1	4.4	8.2
65-69.9	5.2	1.3	6.0	7.3
70-74.9	5.3	1.7	4.8	11.8
75-79.9	3.7	2.2	5.3	11.0
80-84.9	3.6	2.5	6.0	12.8
85-89.9	2.6	3.7	6.1	13.9
90-94.9	1.7	3.5	7.1	16.6
≥95	1.4	5.3	4.5	19.8
All ages	3.8	2.6	5.6	12.4

**Table 3.** Logistic regression to assess the risk of adverse outcomes between patients admitted for hip operations compared to those admitted with acute general medical conditions

Model 1: Unadjusted	Hip operation compared with acute general medical conditions (reference group)					
	In-hospital mortality			Hospital LOS ≥3 weeks		
Age bands (years)	OR	95%CI	P	OR	95%CI	P
60-64.5	0.42	0.13-1.41	0.161	1.43	0.74-2.77	0.285
65-69.9	0.51	0.18-1.46	0.206	2.30	1.40-3.77	0.001
70-74.9	0.26	0.10-0.65	0.004	2.39	1.60-3.57	<0.001
75-79.9	0.40	0.25-0.63	<0.001	3.08	2.38-4.06	<0.001
80-84.9	0.38	0.26-0.56	<0.001	3.15	2.52-3.95	<0.001
85-89.9	0.46	0.34-0.61	<0.001	2.47	2.03-3.01	<0.001
90-94.9	0.42	0.30-0.59	<0.001	2.65	2.08-3.38	<0.001
≥95	0.63	0.40-1.00	0.050	2.94	2.03-4.26	<0.001
Model 2: Adjusted for sex						
Age bands (years)	OR	95%CI	P	OR	95%CI	P
60-64.5	0.42	0.13-1.40	0.158	1.43	0.74-2.77	0.293
65-69.9	0.49	0.17-1.44	0.195	2.69	1.61-4.49	<0.001
70-74.9	0.27	0.11-0.69	0.006	2.51	1.67-3.78	<0.001
75-79.9	0.44	0.27-0.70	0.001	3.34	2.51-4.45	<0.001
80-84.9	0.40	0.27-0.60	<0.001	3.18	2.53-4.00	<0.001
85-89.9	0.50	0.37-0.67	<0.001	2.46	2.01-3.00	<0.001
90-94.9	0.45	0.32-0.63	<0.001	2.73	2.13-3.50	<0.001
≥95	0.67	0.42-1.06	0.086	2.95	2.03-4.29	<0.001

operations compared to those admitted with acute general medical conditions. Both study groups showed significantly increasing trends of mortality with age: P <0.001 (Figure 2). Logistic regression showed the risk of mortality in hospital was lower for those admitted for a hip operation: the sex-adjusted OR ranged between 0.27 and 0.67 (Table 3).

### Comparison of length of stay in hospital

The LOS in hospital increased significantly with age in both groups of patients (Kruskal-Wallis tests: P <0.001). Moreover, within each age band the LOS in hospital was longer for patients admitted for a hip operation than those admitted with acute general medical conditions (Mann-Whitney U tests: P <0.001). Amongst the eight groups of every five-year band from 60 to ≥95 years, the median (interquartile range) values for LOS of patients undergoing hip operations were 7.9 (4.1-13.1), 9.4 (5.7-15.5), 10.1 (7.1-16.7), 11.6 (7.3-22.9), 13.4 (8.4-23.2), 15.1 (9.2-24.8), 15.2 (9.4-26.9), and 16.2 (10.1-

28.5) - Figure 3A. The corresponding values for those with acute general medical conditions were: 1.3 (0-4.3), 1.5 (0-4.6), 2.1 (0.1-7.1), 3.0 (0.3-9.5), 4.8 (0.8-11.5), 6.3 (1.4-16.2), 6.9 (2.1-16.0), and 7.1 (2.0-14.3). Within each study group, LOS increased significantly with age (Kruskal-Wallis tests: P <0.001), and within each age band, LOS differed significantly between the two study groups (Mann-Whitney U tests: P <0.001: Figure 3A).

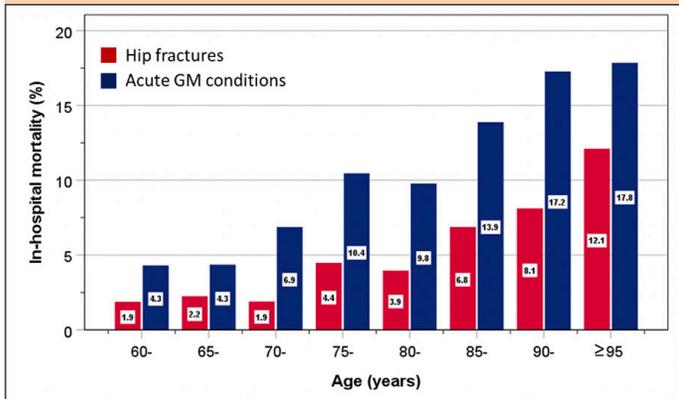
There were also higher proportions with prolonged LOS (≥3 weeks) with age in both study groups (Mantel-Haenszel tests: P <0.001; Figure 3B). Logistic regression also showed that the risk of prolonged LOS was greater for those admitted for hip operation in all age categories: sex-adjusted OR ranged between 2.46 and 2.95 (Table 3).

### Discussion

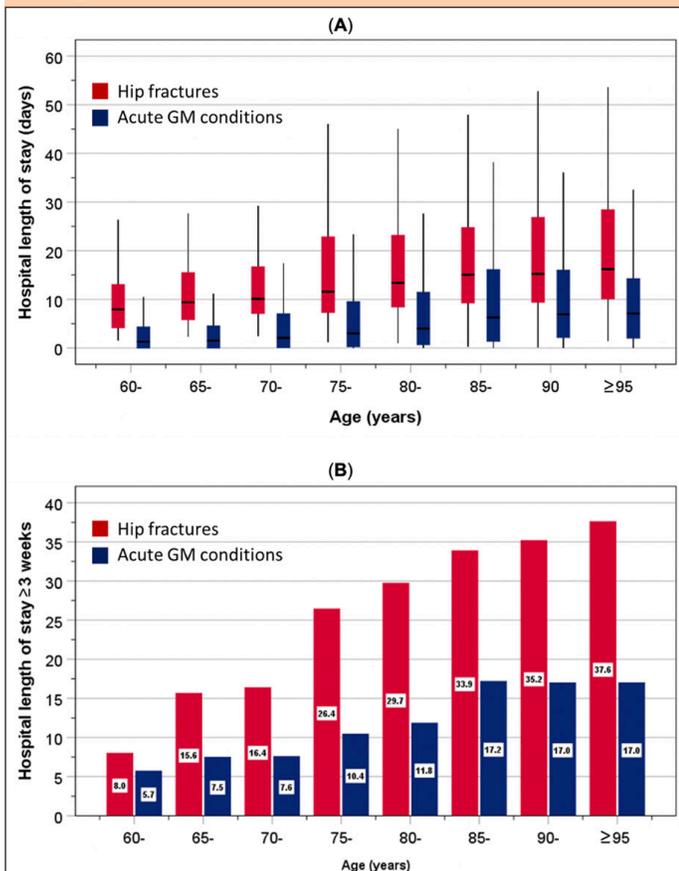
This study shows that for any given age from the age of 60 years patients undergoing hip operations stayed in hospital

longer compared to those admitted with acute general medical conditions, but they had a lower risk of death. To the best of our knowledge, no previous studies have compared in a single centre care-quality measures of patients admitted for hip operation with respect to age-matched patients admitted with acute general medical conditions.

**Figure 2.** Mortality according to age bands in patients admitted for a hip operation and those with an acute general medical (GM) condition



**Figure 3.** Hospital length of stay as a continuous variable (A) and or as a proportion staying  $\geq 3$  weeks (B) according to age bands in patients admitted for either a hip operation or with an acute general medical condition



Surgery is important to an individual who has sustained a hip fracture to alleviate disability and be more likely to

allow independent living (19-21). Our findings of a lower risk of mortality amongst those who underwent hip operations, compared to age-matched patients with acute general medical conditions, suggest that age is not a limiting factor to hip surgery. This is at variance to a common notion that older individuals undergoing surgery for hip fractures are at increased risk of death. Previous studies did not include a comparator group (11-13), or used incompatible control groups, such as those comprising younger patients (9, 10, 14). Some studies also compared mortality with standardised mortality of the general population (22, 23). Our findings of increasing adverse outcomes with age in either study group were, however, consistent with previous observations (9, 10, 14, 17, 18). The higher proportion of females to males is also similar to previous studies of hip fracture patients (24, 25). Two important and novel findings have thus emerged from our study. Firstly, for a given age, mortality rates amongst patients admitted for hip operations were lower than those admitted with acute general medical conditions. Secondly, these differences were constant across all ages. These patterns were also observed with respect to prolonged LOS.

The present study included a relatively large number of older individuals over 80 years. Previous figures have reported 0.7% of total patients admitted for hip operations were centenarians (26) compared to 0.9% in this study. The group of 37 centenarians undergoing hip operations in our study was one of the highest reported for a single centre. However, even with this number, it is difficult to obtain meaningful statistical results and we therefore combined all those over 95 years into the oldest age band.

The lower rates of mortality amongst patients admitted for hip operations than those admitted with acute general medical conditions is novel. This variance may indicate differences of underlying patient health; worse in those admitted with acute general medical conditions. It is possible that the higher mortality rates amongst patients admitted with general medical conditions could be explained by their primary diagnosis presented at admission including acute myocardial infarct, congestive heart failure, stroke and pneumonia. These conditions can have more serious acute pathologies in older patients than those undergoing an operation for a hip fracture. An alternative explanation may be due to the management of patients undergoing hip fracture surgery who are under the care of a multidisciplinary team of orthogeriatricians and orthopedic surgeons and who receive more detailed assessment with early management of pain, nutrition and mobilisation (16, 27).

Patients admitted with a hip operation stayed in hospital longer than those with acute general medical conditions. The median LOS amongst the oldest age bands was 16 days, shorter than previous observations by Holt et al who reported 26 days for those over 95 and 25 days for those of younger age (10). We have recorded in our previous studies that 25% of all patients admitted for hip operation were transferred to rehabilitation and 4.5% were a new referral to a care home (16). These factors could have an impact on LOS in a number of ways. On the one hand, discharge may be delayed whilst waiting for a rehabilitation place or for nursing care, thus they would have

a longer LOS. Alternatively, once a place in rehabilitation is secured, early discharge support is more readily available. Since LOS increased with age for both studies, the relative differences in LOS, or risk of prolonged LOS ( $\geq 3$  weeks), between the two groups were similar for all ages, including those in very old age groups.

The strengths of this study lie in its relatively large number of patients derived from a single NHS hospital that serves a population of >400,000 people. There were certain limitations including the time frames over which data were collected, where the majority of patients requiring a hip operation were admitted at earlier times than those admitted with acute general medical conditions. The management of hip fracture patients has improved over the past decade (16), so that their favourable care-quality indicators observed in this study might have been underestimated. Our findings may be biased by the use of patients with acute general medical conditions as a reference group, but we were able to eliminate age as a variable, which has not been performed in previous studies. However, caution should be taken when interpreting our findings, particularly with respect to LOS, which could be influenced by different discharge pathways between patients with hip fractures and those with acute general medical conditions. Ideally, further analysis of discharge destinations (own home or nursing/residential care) should be conducted to compare LOS between these two study groups.

In conclusion, compared to those admitted with acute general medical conditions, patients admitted for hip operations had a longer LOS in hospital, but a lower risk of death. However, for both variables these differences were independent of age, including patients over 90 years of age. Our findings suggest that it is safe for individuals of very old age to undergo hip surgery, and so alleviate any disability to improve their independence and quality of life.

**Contributions:** TSH and DF reviewed the topic related literature and performed the study concept and analysis design. RL, KY, JR and DF performed the study coordination and data collection and commented on the manuscript. TSH wrote the first draft, analysed, interpreted the data and revised the manuscript. CHF edited the manuscript. All authors checked, interpreted results and approved the final version.

**Ethical approval:** This study does not require NHS Research Ethics Committee approval since it involves secondary analysis of anonymised data. This study was conducted in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Statement of human and animal rights:** This article does not contain any studies with animals performed by any of the authors. Informed consent was obtained from all individual participants included in the study.

**Conflict of interest:** David Fluck, Christopher H Fry, Radcliffe Lisk, Keefai Yeong, Jonathan Robin, and Thang S Han declare that they have no conflicts of interest.

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