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Shorter length of stay is associated with decreased early mortality after hip fracture: a total cohort study in the United States

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Authorship:
- LN, SK, MS, JE contributed to the conception or design of the work;
- LN, MM, BM, JE contributed to the acquisition of data;
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- LN, SK, MS, MM, BM, JE contributed to the interpretation of data for the work;
- LN, SK, MS, MM, BM, JE contributed to drafting the work and revising it critically for important intellectual content;
- LN, SK, MS, MM, BM, JE gave final approval of the version to be published;
- LN, SK, MS, MM, BM, JE agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Statement of Ethics Approval:
This study was approved by the New York State Department of Health, Bureau of Health Informatics Data Protection Review Board, the New York State Department of Vital Statistics, the New York City Department of Health and Mental Hygiene, and the University of Rochester Research Subjects Review Board

Transparency declaration:
Lucas E Nikkel and John C Elfar (lead author and senior corresponding authors, respectively) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; no important aspects of the study have been omitted; and any discrepancies from the study as planned have been explained.

ABSTRACT:

Objective: To determine if the length of stay after hip fracture is associated with risk of mortality following discharge in the United States.

Design: Retrospective cohort study

Context: Recent Swedish registry data has suggested that increased hospital length of stay is associated with a decreased 30-day mortality following discharge for hip fracture. However, critical system differences exist in treatment of hip fracture in Europe and the United States.

Setting: Population-based registry data from New York Statewide Planning and Research Cooperative System (SPARCS) from 2000-2011.

Participants: 188 208 patients admitted with a hip fracture in New York State 50 years of age and older between 2000 and 2011.

Interventions: Surgical and non-surgical treatment.

Main outcome measure: Mortality rate 30 days after discharge from the hospital.

Results: Early hospital discharge is associated with fewer comorbid conditions and decreased early mortality. Compared with a length of stay of 1-5 days, length of stay of 6-10 days was associated with an 8% increased risk of mortality (hazard ratio 1.08 (95% confidence interval 1.03 to 1.14)), length of stay 11-14 days was associated with 43% increased risk (hazard ratio 1.43 (1.33 to 1.54), and length of stay >14 days was associated with 98% increased risk (hazard ratio 1.98 (1.85 to 2.12)). Other risk factors associated with early mortality include discharge to a

hospice facility, older age, metastatic disease, and non-surgical management. The mortality rate was 4.5% for surgically treated patients and 10.7% for non-surgically treated patients in the first 30 days after hospital discharge.

Conclusions: Our findings show the exact opposite trend in a United States population with respect to length of stay and mortality risk as those from the Swedish registry data. In New York State, decreased length of stay was associated with lower early mortality following discharge after hip fracture.

What is already known on this subject:

- Shorter hospital length of stay is associated with increased risk of mortality in a Swedish population
- Increased comorbid conditions are associated with increased costs and longer hospital length of stay following hip fracture in the United States

What this paper adds:

- Hospital length of stay greater than 5 days was associated with increased risk of death after hospital discharge in a United States population
- Nonsurgical treatment of hip fractures was associated 10.7% mortality compared with 4.5% treated surgically at 30 days after discharge
- Risk factors associated with early mortality include discharge to a hospice facility, older age, metastatic disease, and non-surgical management.

INTRODUCTION:

Hip fracture is common, costly and often associated with poor outcomes amongst older adults. Mortality rates after hip fracture have changed little over the past 30 years despite surgical and medical improvements.[1] Nonetheless, mortality rates are universally measured in registries and large databases. The length of hospital stay (LOS) has fallen over time in both Europe and the United States.[2] Recent work has suggested that a longer LOS after hip fracture is associated with decreased mortality following discharge.[3]

Healthcare systems in Europe and the United States differ in both LOS and usual discharge destination. In the United States, 90% of hip fracture patients are discharged to rehabilitation facilities and receive much of their follow up care in these facilities.[4] Rehabilitation facilities in the United States serve a transitional role and may help prevent early mortality after discharge.[5]

The New York Statewide Planning and Research Cooperative System (SPARCS) database offers a unique opportunity to measure postoperative mortality in a complete data set of United States patients and has been used previously to study hip fractures.[6] We hypothesized that SPARCS data would demonstrate shorter LOS is associated with lower 30-day mortality rates after hip fracture.

METHODS

Patients:

This study used the New York Statewide Planning and Research Cooperative System (SPARCS) database to identify a retrospective cohort of 188 938 patients aged 50 years or more admitted to a New York State public or private hospital in between January 1, 2000 and December 31, 2011 with a hip fracture.

Patients were identified from hospital discharge records originating from non-rehabilitation hospitals in the State of New York containing an admitting or primary diagnosis code for a hip fracture using the ICD-9-CM classification (ICD-9-CM codes 820.00-820.03, 820.09, 820.20-820.22, 820.8). Patients were excluded if missing the unique personal identifier (encrypted combination of name, date of birth, social security number, hospital, and date of admission; N=68) or for duplicate unique identifiers (N=662). The remaining 188,208 patients were included in the analysis. Mortality data was determined using a linkage with the New York State Department of Vital Statistics and New York City Department of Vital Statistics extending through December 31, 2012.

Surgical procedure and date were identified with ICD-9 procedure codes (81.51, 81.52, 78.55, 73.35, 79.15, 79.25, or 79.05) and associated procedure dates. Time to surgery was defined as days between admission and procedure date. Comorbidities were defined based on the Charlson Comorbidity Index using a STATA interpretation of a SAS software program obtained from the Boston College Department of Economics in its series Statistical Software Components.[7]

Statistical methods:

The primary analysis was designed to determine whether LOS, categorically defined as 1-5 days, 6-10 days, 11-14 days, and greater than 14 days, was associated with mortality rates at 30 days

after hospital discharge. Differences between categorical groups were assessed with chi-squared analysis and between categorical variables with Student's t-test. Patients who died prior to discharge were excluded from analyses related to post-discharge mortality. Survival estimates were determined with the Kaplan-Meier method. Multivariate proportional hazard regression evaluated risk of mortality following discharge based on categorical LOS while adjusting for covariates found to be significantly associated with 30-day mortality on univariate analysis ($p<0.05$). Analyses were performed with the use of Stata statistical software (version 13.1 StataCorp, College Station, Texas).

To evaluate whether non-surgically treated patients were dying soon after discharge and contributing to increased early mortality, three models were created: (1) all patients with a hip fracture regardless of surgical management, where non-surgical management was included as a covariate, (2) patients treated surgically excluding those treated non-surgically, and (3) patients treated non-surgically, excluding those treated surgically.

RESULTS:

188 208 patients admitted with a hip fracture between 2000 and 2011 met inclusion criteria; 169,258 were treated surgically and 18 950 were treated non-surgically. The average LOS was 8.1 days (range 1-995 days; SD 8.3). During hospitalization, 7 364 patients died leaving 180 844 survivors for post-discharge analysis. During the 30-day period after discharge, 9 179 additional patients died. During the study period, the average LOS decreased from 12.9 days in 2000 to 5.6 days in 2011.

The majority of patients were hospitalized for less than 10 days (patient characteristics shown in Table 1). For surgically treated patients, the average time to surgery was 1.8 days (SD 2.1, range 0-128); a longer time to surgery was associated with longer LOS.

On univariate analysis multiple factors were associated with increased 30-day mortality including non-surgical treatment, male gender, Caucasian race, older age, longer time to surgery, blood transfusion, comorbid conditions and discharge to hospice (Table 2 shows risk factors for mortality). A shorter LOS (less than 5 days and less than 10 days) was also associated with decreased 30-day mortality. Mortality rates did not change between the first 6 years and the last 6 years of the study. The mortality rate for surgically treated hip fracture patients was 4.5% in the 30 days after discharge. The 30-day post-discharge mortality rate for non-surgically treated hip fracture patients was 10.7%.

On multivariate regression analysis, discharge to a hospice facility and age >90 years were the largest risk factors for mortality. Compared to a LOS ≤ 5 days, a longer length of stay was associated with increased risk of mortality during the first 30 days after discharge.

Patients with greater LOS had lower survival rates on Kaplan-Meier analysis (Figure 1a). LOS did not influence mortality rates for non-surgically treated patients when analyzed separately (Figure 1b). For surgically treated patients, increased LOS was associated with increased mortality rates, and this trend was dominant in the overall cohort of all hip fracture patients.

DISCUSSION:

The relationship between hospital LOS and mortality is important if altering LOS influences mortality rates. Prior studies and our results suggest that an increased comorbidity burden is associated with increased hospital LOS.[8,9] This highlights the relationship between a patient's pre-injury health status and LOS. In this study of New York State patients, a shorter inpatient hospital stay was associated with increased rates of survival after hip fracture.

These findings contrast sharply with the results of Nordström et al. in a recent Swedish study in which shortened LOS was associated with increased mortality rates.[3] These different results suggest different influences on mortality rates exist in these two distinct populations. The Swedish cohort contained 116 111 patients but did not distinguish results between fractures managed surgically and non-surgically. The prevalent standard of care for hip fracture is surgical treatment in all patients who can tolerate surgery. Non-surgical management is chosen for those patients medically unfit for surgery, unwilling to consent for surgery, or with a short life expectancy where palliative measures are more appropriate. In our study, non-surgically managed patients fared predictably poorly regardless of hospital LOS. However, exclusion of these patients from the fracture cohort did not alter the overall improved mortality rates in patients with shorter LOS. In the Nordström study, no analysis was performed to assess the number of patients managed non-surgically or their outcomes with regards to mortality as a function of LOS. Additionally, their study lacked information on time to surgery in operatively treated patients. In our study, increased time to surgery was associated with longer LOS. With the known relationship in the hip fracture literature between increased time to surgery and mortality,[10 11] interpretation of their results would require knowledge of the average time to surgery for Swedish hip fracture patients.

There are several important limitations to this study. Administrative claims data may be incomplete or contain inaccurate coding of diagnoses and comorbid conditions. However, comorbidities that would impact reimbursement and acuity indices would likely have been included. The SPARCS dataset does not contain laboratory values or permit assessment of the severity of comorbid illness, and it does not include the American Society of Anesthesiologists (ASA) classification.

The fracture date was not recorded in relation to admission date. Some patients sustain a hip fracture while hospitalized for another condition, biasing these patient's records toward longer LOS. To control for this effect, we purposefully included only patients whose admission or primary diagnosis was for hip fracture. Differences in study populations between our study and others also represent a limitation as care in New York State varies with location, and socioeconomic factors, which may not be present in single-nation European populations.[4]

In conclusion, the relationship between LOS and mortality after hip fracture in New York State differs significantly from that seen in a Swedish population. Earlier discharge is associated with improved survival and longer LOS likely represents a surrogate for medical comorbidities or complications occurring in the hospital that delayed a safe, early discharge. This critical difference suggests prolonging hospitalization would not improve mortality outcomes in the US population.

TABLE AND FIGURE LEGEND:

Table 1: Characteristics of 180 844 patients with hip fracture in New York State, 2000-2011, stratified by length of stay (excluding patients deceased during hospitalization).

Table 2: Variables associated with risk of 30-day mortality following discharge for femoral neck fracture, excluding patients deceased during hospitalization.

Figure 1: 30-day Kaplan-Meier survival graphs after hip fracture discharge for (A) all patients and (B) non-surgically treated patients. Shorter LOS was associated with higher survival rates in the all patients group but LOS did not influence survival rates in non-surgically treated patients.

Table 1

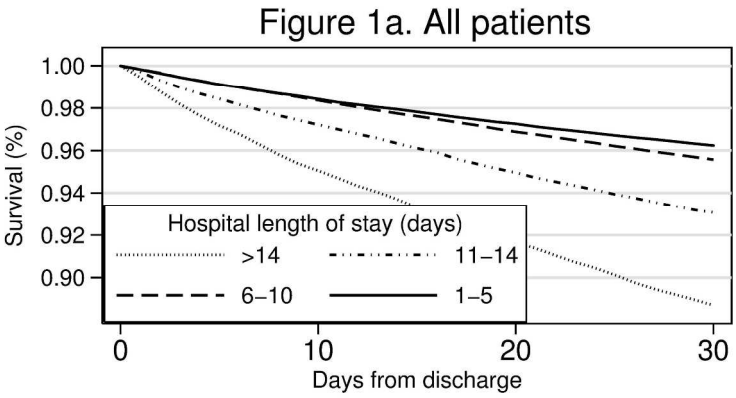
	Length of hospital stay (days)			
	0-5	6-10	11-14	>14
Demographics and mortality				
Number of patients (%)	71 780 (39.7)	76 700 (42.4)	17 063 (9.4)	15 301 (8.5)
Female (%)	55 119 (76.8)	57 389 (74.8)	11 964 (70.1)	9 944 (65.0)
Mean age in years (StDev)	80.7 (10.3)	81.8 (9.5)	81.7 (9.6)	80.9 (10.0)
Non-surgical treatment (%)	8 609 (12.0)	3 987 (5.2)	1 725 (10.1)	2 272 (14.8)
30-day mortality if treated surgically (%)	1 864 (3.0)	2 991 (4.1)	1 033 (6.7)	1 519 (11.7)
30-day mortality if treated non-surgically (%)	910 (10.6)	446 (11.2)	171 (9.9)	245 (10.8)
Main diagnosis				
Femoral neck fracture (%)	21 184 (29.5)	22 023 (28.7)	4 677 (27.4)	4 090 (26.7)
Intertrochanteric fracture (%)	50 596 (70.5)	54 677 (62.3)	12 386 (72.6)	11 211 (73.3)
Surgical variables				
Hemiarthroplasty (%)	17 084 (23.8)	22 756 (29.7)	5 084 (29.8)	4 303 (28.1)
Total hip arthroplasty (%)	1 820 (2.5)	2,224 (2.9)	442 (2.6)	371 (2.4)
Open reduction internal fixation (%)	29 379 (40.9)	36 083 (47.0)	7 828 (42.7)	6 620 (43.3)
Other fixation (%)	14 933 (20.8)	11 679 (15.2)	1 994 (11.7)	1 742 (11.4)
Time to surgery if treated surgically (StDev)	0.9 (0.7)	1.8 (1.3)	3.0 (2.4)	5.2 (8.5)
Required transfusion (%)	22 551 (31.4)	33 326 (43.4)	7 996 (46.9)	7 384 (48.3)
Comorbid conditions				
Dementia (%)	3 189 (4.4)	4 130 (5.4)	1 020 (6.0)	935 (6.1)
Acute myocardial infarction (%)	3 810 (5.3)	5 597 (7.3)	1 862 (10.9)	2 033 (13.3)
Cerebrovascular disease (%)	3 144 (4.4)	4 531 (5.9)	1 383 (8.1)	1 350 (8.8)
Chronic obstructive pulmonary disease (%)	11 640 (16.2)	14 401 (18.8)	3 736 (21.9)	3 750 (24.5)
Diabetes mellitus (%)	11 529 (16.1)	13 942 (18.2)	3 313 (19.4)	2 817 (18.4)
Renal disease (%)	3 603 (5.0)	4 991 (6.5)	1 463 (8.6)	1 580 (10.3)
Cancer (%)	1 780 (2.5)	2 356 (3.1)	647 (3.8)	691 (4.5)
Metastatic disease (%)	660 (0.9)	940 (1.2)	270 (1.6)	377 (2.5)
Diabetes with complications (%)	884 (1.2)	1,430 (1.9)	432 (2.5)	555 (3.6)
Congestive heart failure (%)	6 726 (9.4)	11 555 (15.1)	3 835 (22.5)	4 448 (29.1)
Weighted Charlson score (StDev)	0.9 (1.2)	1.1 (1.3)	1.4 (1.4)	1.6 (1.6)
Disposition				
Long-term care (%)	519 (0.7)	746 (1.0)	145 (0.8)	191 (1.2)
Skilled nursing facility (%)	39 691 (55.3)	47 059 (61.4)	10 485 (61.4)	9 443 (61.7)
Left against medical advice (%)	360 (0.5)	81 (0.1)	22 (0.1)	30 (0.2)
Cancer hospital (%)	6 016 (8.4)	8 013 (10.4)	1 677 (9.8)	1 197 (7.8)
Home (%)	4 921 (6.9)	4 823 (6.3)	1 456 (8.5)	1 511 (9.9)
Home health agency (%)	4 116 (5.7)	3 571 (4.7)	1 101 (6.5)	1 280 (8.4)
Hospice (%)	333 (0.5)	314 (0.4)	149 (0.9)	291 (1.9)
Inpatient hospital (%)	3 063 (4.3)	1174 (1.5)	297 (1.7)	289 (1.9)
Inpatient rehabilitation (%)	12 641 (17.6)	10 791 (14.1)	1 704 (10.0)	1 024 (6.7)

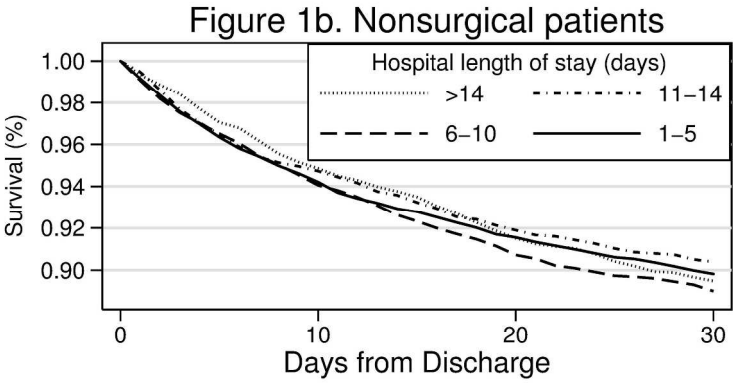
Table 2

	Univariate analysis			Multivariate analysis			
	Survived N=171 665	Deceased N=9 179	P-value	Hazard ratio	95% CI		P-value
No surgery	8.63	19.3	<0.001	2.04	1.92	2.17	<0.001
Female	74.84	64.81	<0.001	0.61	0.59	0.64	<0.001
Race							
White	86.1	88.9	<0.001	(Reference)			
Black	4.2	3	<0.001	0.74	0.65	0.84	<0.001
Other	8	7	<0.001	0.92	0.85	1.00	0.04
Age (SD)	81.0 (9.9)	86.0 (8.0)	<0.001				
50-59 years	4.3	0.7	<0.001	(Reference)			
60-69 years	8.7	3.2	<0.001	1.94	1.48	2.55	<0.001
70-79 years	23.4	14.1	<0.001	2.89	2.24	3.71	<0.001
80-89 years	45	46.3	0.011	4.66	3.64	5.98	<0.001
>90 years	18.7	35.7	<0.001	8.01	6.24	10.29	<0.001
Femoral neck fracture	28.78	27.97	0.09	1.02	0.97	1.07	0.401
Days to surgery	1.7 (2.0)	2.2 (3.0)	<0.001				
>2 days	17.4	21.7	<0.001	1.11	1.05	1.17	<0.001
Received transfusion	39.1	45.1	<0.001	1.19	1.13	1.24	<0.001
Comorbidities							
Dementia	4.9	9.6	<0.001	1.52	1.41	1.63	<0.001
Cardiac disease (acute)	7.1	12.1	<0.001	1.18	1.11	1.26	<0.001
Cerebrovascular disease	5.7	7.7	<0.001	1.18	1.09	1.27	<0.001
COPD	18.2	25.4	<0.001	1.33	1.27	1.39	<0.001
Diabetes	17.5	16.8	0.09	1.00	0.94	1.05	0.908
Renal disease	6.2	11.5	<0.001	1.32	1.23	1.42	<0.001
Cancer	2.9	5.5	<0.001	1.44	1.31	1.58	<0.001
Metastatic disease	1.1	4.4	<0.001	2.52	2.26	2.80	<0.001
Diabetes with complications	1.8	1.7	0.55	0.99	0.84	1.17	0.928
Congestive heart failure	13.9	30.2	<0.001	1.66	1.59	1.75	<0.001
Weighted Charlson sum	1.0 (1.3)	1.8 (1.8)	<0.001				
Length of stay (days)							
1-5	40.2	30.2	<0.001	(Reference)			
6-10	42.7	37.4	<0.001	1.08	1.03	1.14	0.004
11-14	9.2	13.1	<0.001	1.43	1.33	1.54	<0.001
>14	7.9	19.2	<0.001	1.98	1.85	2.12	<0.001
Disposition							
Skilled nursing facility	58.5	67.8	<0.001	(Reference)			
Long-term care	0.9	1	0.145	1.06	0.86	1.30	0.578
Left against medical advice	0.3	0.2	0.216	0.65	0.41	1.02	0.061
Cancer center	9.6	5.5	<0.001	0.62	0.56	0.68	<0.001
Home	7.2	4.3	<0.001	0.62	0.56	0.69	<0.001
Home health	5.7	2.7	<0.001	0.49	0.43	0.56	<0.001
Hospice	0.1	9.4	<0.001	16.41	15.12	17.81	<0.001
Inpatient hospital	2.6	3.7	<0.001	1.05	0.94	1.18	0.388
Inpatient rehabilitation	15	5.3	<0.001	0.42	0.39	0.47	<0.001
Year 2006-2011	49.8	49.1	0.157	0.86	0.82	0.90	<0.001

References

1. Brauer CA, Coca-Perraillon M, Cutler DM, et al. Incidence and mortality of hip fractures in the United States. JAMA 2009;**302**(14):1573-9.
2. Fenton JJ, Jerant AF, Bertakis KD, et al. The cost of satisfaction: a national study of patient satisfaction, health care utilization, expenditures, and mortality. Archives of internal medicine 2012;**172**(5):405-11.
3. Nordstrom P, Gustafson Y, Michaelsson K, et al. Length of hospital stay after hip fracture and short term risk of death after discharge: a total cohort study in Sweden. Bmj 2015;**350**:h696.
4. Goodman DC, Fisher, E.S., Chang, C.H. After hospitalization: a Dartmouth Atlas report on post-acute care for Medicare beneficiaries. In: project ArotDA, ed. Hanover, NH: Dartmouth, 2011.
5. Lahtinen A, Leppilahti J, Harmainen S, et al. Geriatric and physically oriented rehabilitation improves the ability of independent living and physical rehabilitation reduces mortality: A randomised comparison of 538 patients. Clin Rehabil 2014.
6. Boockvar KS, Halm EA, Litke A, et al. Hospital readmissions after hospital discharge for hip fracture: surgical and nonsurgical causes and effect on outcomes. J Am Geriatr Soc 2003;**51**(3):399-403.
7. Stagg V. CHARLSON: Stata module to calculate Charlson index of comorbidity. Secondary CHARLSON: Stata module to calculate Charlson index of comorbidity 2006. http://econpapers.repec.org/software/bocbocode/s456719.htm.
8. Nikkel LE, Fox EJ, Black KP, et al. Impact of comorbidities on hospitalization costs following hip fracture. The Journal of bone and joint surgery American volume 2012;**94**(1):9-17.
9. Roche JJ, Wenn RT, Sahota O, et al. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. BMJ 2005;**331**(7529):1374.
10. Bottle A, Aylin P. Mortality associated with delay in operation after hip fracture: observational study. BMJ 2006;**332**(7547):947-51.
11. Moran CG, Wenn RT, Sikand M, et al. Early mortality after hip fracture: is delay before surgery important? J Bone Joint Surg Am 2005;**87**(3):483-9.





30-day Kaplan-Meier survival graphs after hip fracture discharge for (A) all patients and (B) non-surgically treated patients. Shorter LOS was associated with higher survival rates in the all patients group but LOS did not influence survival rates in non-surgically treated patients.
203x295mm (300 x 300 DPI)