Mortality Rates are Similar after Hip Fractures for Rural and Urban Patients

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Abstract

Background Proximal femoral fractures are common in the elderly. The best care depends on expeditious presentation, medical stabilization, and treatment of the condition.

Questions/purposes We investigated the risk of increased mortality in residents of rural communities secondary to inaccessible facilities and treatment delays.

Patients and Methods We used Medicare Provider Analysis and Review Part A data to identify 338,092 patients

with hip fractures. Each patient was categorized as residing in urban, large rural, or small rural areas. We compared the distance traveled, mortality rates, time from admission to surgery, and length of stay for patients residing in each location.

Results Patients in rural areas traveled substantially farther to reach their treating facility than did urban patients: mean, 34.4 miles for small rural, 14.5 miles for large rural, and 9.3 miles for urban. The adjusted odds ratios for mortality were similar but slightly better for urban patients for in-hospital mortality (small rural odds ratio, 1.05; large rural odds ratio, 1.13). Rural patients had a favorable adjusted odds ratio for 1-year mortality when compared with urban patients (small rural odds ratio, 0.93; large rural odds ratio, 0.96). Rural patients experienced no greater delay in time to surgery or longer hospital length of stay.

Conclusions Although patients living in rural areas traveled a greater distance than those living in urban centers, we found no increase in time to surgery, hospital length of stay, or mortality.

Level of Evidence Level III, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

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Introduction

Proximal femoral (hip) fractures are a common cause of morbidity, mortality, and hospitalization in the elderly, affecting more than 340,000 patients annually in the United States [6–8, 20, 28, 30]. Although the relative incidence of such fractures appears to be decreasing [7, 18], the absolute number of hip fractures continues to increase as a result of the aging population [14]. Previous investigations have established a benefit in expeditious presentation, medical stabilization, and treatment of this condition [20, 27, 30]. An integral component to the appropriate management of hip fractures is timely presentation to a hospital that can provide definitive treatment.

Rural Americans face an array of barriers to specialized medical care, most notably a lack of available specialists resulting in the need to travel long distances to obtain certain services [4]. Long travel distances might simply be an inconvenience for patients with chronic medical conditions (eg, hypertension, diabetes), but in the case of medical emergencies such as acute hip fractures, extended distances and resultant treatment delays could increase patient mortality. Patients who live in rural areas, greater than 20% of the US population [31], may be at risk for suboptimal care owing to a delay in presentation or treatment. Potential delays to treatment, once the patient is admitted, may include lack of specialty services, staffing issues delaying clearance for surgery, and unavailability of operating rooms.

Although we are unaware of prior evaluation of hip fracture outcomes among urban and rural populations, previous studies of acute myocardial infarction, a condition with a greater degree of urgency, may be informative. Some studies have found lower guideline adherence, lower rates of cardiac revascularization, and higher mortality at rural hospitals compared with urban counterparts suggesting rural Americans may have reduced access to high-quality cardiac care [1, 5, 25]. Thus, although there is reason to suspect rural patients with hip fractures could have reduced access to high-quality hospitals and increased mortality compared with urban populations, the existing literature is limited [30].

We asked whether rural patients with hip fractures (1) traveled farther distances to receive treatment than urban patients, and if the distance traveled correlated with (2) increased mortality, (3) increased delays in time to surgery, or (4) increased hospital length of stay (LOS).

Patients and Methods

We used Medicare Provider Analysis and Review (MedPAR) Part A data files [17] to identify fee-for-service

beneficiaries who sustained a fracture of the femoral neck (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] diagnosis code 820.X) from July 1, 2006, to June 30, 2008. MedPAR data have been used extensively in orthopaedic health services research [9, 16]. Key data elements include patient demographics, admission source, admission and discharge dates, place of discharge, ICD-9-CM codes for diagnoses and procedures, zip code of residence, patient mortality occurring within 3 years of hospitalization, each patient's unique Medicare beneficiary number, and the unique hospital identification number. We limited our analysis to each patient's initial presentation with a hip fracture to avoid including patients whose admissions were readmissions or attributable to complications from a previous fracture. Specifically, we excluded patients with an admission for a previous hip fracture during the 6 months preceding the index admission for hip fracture. Patients with previous admissions for hip fracture that occurred greater than 6 months before another admission were considered more likely to have a second fracture rather than a complication and were included. We categorized each fracture on the basis of location as closed transcervical fracture (ICD-9 820.0), closed pertrochanteric fracture (ICD-9 820.2), and closed unspecified part of neck of femur fracture (ICD-9 820.8) because each of these diagnoses fall under the general term hip fracture. We excluded open fractures from the analysis because treatment of these injuries is considerably different from that for the typical fracture and does not warrant inclusion in our analysis. We excluded patients who initially were admitted at one facility and transferred to a second hospital for definitive surgery ($n = 2328$). This was an uncommon occurrence in our cohort, accounting for only 0.5% of patients, and their elimination was unlikely to make a difference in the final analysis. We excluded patients younger than 65 years because such patients are not representative of the general Medicare population, patients with incomplete demographic data, and patients admitted to a facility other than an acute care hospital (Fig. 1). We also excluded patients admitted to a hospital located 250 miles or more from their residence, in accordance with previous investigators, because such patients likely sustained their hip fracture while traveling and would confound the relationship among residence, distance, and admitting hospital [4]. Comorbid conditions were identified using algorithms described by Elixhauser et al. [13]. Our final sample included 338,092 patients who experienced hip fractures from July 1, 2006, to June 30, 2008, of whom 14.4% (48,583) lived in small rural areas, 13.5% (45,521) lived in large rural areas, and 72.1% (243,988) lived in urban areas. There were clinically small but statistically significant differences in demographics and comorbidities among patients residing in our three

Fig. 1 A flow chart shows patient selection. IF = internal fixation, HA = hemiarthroplasty, SNF = skilled nursing facility, RUCA = rural-urban commuting area, AHA = American Hospital Association.

regions (Table 1). This study was approved by our Institutional Review Board.

We used each patient's zip code of residence to determine the ruralness of the location where each patient lived. Specifically, we applied the Rural-Urban Commuting Area (RUCA) classification system [31], which classifies all zip codes in the United States as small rural (codes 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6), large rural (codes 4.0, 4.2, 5.0, 5.2, 6.0, and 6.1), and urban (codes 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1). These definitions loosely correlate with a zip code near a population center of greater than 50,000 for urban, 10,000 to 49,999 for large rural, and less than 10,000 for small rural. The RUCA codes also account for relative proximity to an urban area (ie, a rural area located just outside a major city) by assigning different

codes to places with a substantial number of commuters to an adjacent city. RUCA categorization has been used previously in these types of analyses [4]. We applied these codes to classify each patient's residence into one of three categories (small rural, large rural, or urban). Relatively few patients were treated at hospitals located in small rural areas (3.5% of all patients, 21.1% of patients living in small rural areas) (Table 2). The majority of the treating hospitals (80.4%) were located in urban areas. Urban patients were more likely ($p < 0.001$) to be treated at larger hospitals than patients residing in large or small rural areas. The dominant mode of admission for all patients was through the emergency department.

We linked the MedPAR data to the American Hospital Association (AHA) annual survey data [3]. The AHA data provide hospital-level information including number of

Table 1. Individual characteristics by location of residence

Characteristic	Patient residence			p value*
	Small rural (n = 48,583)	Large rural (n = 45,521)	Urban (n = 243,988)	
Demographics				
Age (years), mean (SD)	83.0 (7.9)	83.1 (7.9)	83.3 (7.8)	< 0.001
Race, number (%)				< 0.001
White	46,164 (95.02)	43,386 (95.31)	225,283 (92.33)	
Black	1344 (2.77)	1160 (2.55)	9740 (3.99)	
Other	1075 (2.21)	975 (2.14)	8966 (3.67)	
Female, number (%)	35,657 (73.4)	33,626 (73.9)	179,608 (73.6)	< 0.001
Number of comorbidities, mean (SD)	2.5 (1.4)	2.5 (1.4)	2.6 (1.4)	< 0.001
Hypertension, number (%)	29,163 (60.0)	27,521 (60.4)	147,622 (60.5)	< 0.001
Diabetes—uncomplicated, number (%)	8405 (17.3)	7645 (16.8)	38,193 (15.7)	< 0.0001
Arrhythmia, number (%)	12,142 (25.0)	11,437 (25.1)	64,628 (26.5)	< 0.001
Congestive heart failure, number (%)	9792 (20.2)	8975 (19.7)	44,797 (18.4)	0.15
Chronic obstructive pulmonary disease, number (%)	10,971 (22.6)	10,451 (23.0)	52,904 (21.7)	< 0.001
Type of fracture, number (%)				< 0.001
Pertrochanteric	23,788 (49.0)	22,469 (49.4)	123,854 (50.8)	
Transcervical	12,785 (26.3)	13,279 (29.2)	66,026 (27.1)	
Unspecified	12,010 (24.7)	9773 (21.4)	54,108 (22.2)	
Type of treatment, number (%)				
No surgery	2607 (5.4)	2541 (5.6)	13,032 (5.3)	0.06
Internal fixation	27,854 (57.3)	26,215 (57.6)	143,266 (58.7)	0.27
Hemiarthroplasty	17,007 (35.0)	15,723 (34.5)	82,392 (33.8)	0.95
THA	1362 (2.8)	1260 (2.8)	6542 (2.7)	0.85

* Chi square test was used for categorical data, and ANOVA was used for continuous data.

Table 2. Treating hospital characteristics by location of residence

Characteristic	Patient residence			p value*
	Small rural (n = 48,583)	Large rural (n = 45,521)	Urban (n = 243,988)	
Hospital location, number (%)				< 0.001
Small rural	10,247 (21.1)	722 (1.6)	1003 (0.4)	
Large rural	15,262 (31.4)	35,191 (77.3)	3951 (1.6)	
Urban	23,074 (47.5)	9608 (21.1)	239,034 (98.0)	
Number of beds, mean (median, Q1–Q3)	239.9 (185, 94–332)	196.0 (141, 94–232)	369.7 (307, 199–451)	< 0.001
Nurse staffing ratio, mean (median, Q1–Q3)	3.0 (3.0, 2.4–3.7)	2.9 (2.9, 2.3–3.6)	3.2 (3.1, 2.6–3.7)	< 0.001
Admission source, number (%)				< 0.001
Emergency	30,976 (63.8)	36,023 (79.1)	209,705 (86.0)	
Transfer	4943 (10.2)	1860 (4.1)	3742 (1.5)	
Referral/direct admission	12,450 (25.6)	7571 (16.6)	30,193 (12.4)	
Other	214 (0.4)	67 (0.2)	348 (0.1)	

* Chi square test was used for categorical data, and ANOVA was used for continuous data; Q = quartile.

beds, teaching status, nurse staffing level (calculated as the number of full-time equivalent nurses divided by adjusted patient days), and zip code for each hospital.

We examined an array of diverse outcomes consistent with our effort to examine variation in care for rural and urban patients. Specifically, for small rural, large rural, and

urban patients, we compared mortality (in-hospital, 30-day, and 1-year), elapsed time from hospital admission to surgery, and hospital LOS. Time to surgery was defined as the number of days between each patient's operative procedure and the admission date [19]. Hospital LOS was calculated by subtracting the date of the initial admission from the discharge date.

We also compared the distance from the place of residence to the treating hospital for patients residing in small rural, large rural, and urban areas. Distance was calculated by measuring the linear distances between the centroids of the zip codes of the patients' residences and the hospitals. In addition, for each patient, we noted if there was a closer hospital to the patient's residence that was bypassed in favor of a more distant hospital.

First, we compared differences in demographics, fracture type, and comorbidity among patients who lived in our three geographic regions (small rural, large rural, and urban) using chi square or Fisher's exact test for categorical data and ANOVA for continuous data. We also compared the characteristics of the hospitals (bed size, nurse-staffing ratios) where patients from small rural, large rural, and urban areas were treated. We compared our outcome measures in a similar manner. Specifically, we compared mortality (in-hospital, 30-day, 1-year), discharge disposition (categorized as skilled care, home, rehabilitation, transfer to another acute care hospital, dead [in-hospital], and other), hospital LOS, and time to surgery for patients in small rural, large rural, and urban areas.

We used separate generalized estimating equation (GEE) models to examine the independent impact of patient residence (small rural, large rural, and urban) on mortality after accounting for differences in patient characteristics and hospital factors. Urban residence was considered the reference category in these models. We assumed binomial distribution with a logit link function for binary outcomes (ie, in-hospital mortality, 30-day mortality, and 1-year mortality). All models incorporated hospital-level random effects to account for the hierarchical clustering of patients within hospitals.

Finally, we performed sensitivity analyses to examine the robustness of our findings. First, we repeated our analyses while focusing on patients living 50 to 100 miles from the nearest hospitals; we did this because we suspected that, perhaps, patients from small rural areas living at particularly great distances from the nearest hospital might be at a higher risk for increased mortality resulting from delayed presentation. Second, we repeated our analyses while focusing exclusively on patients with at least two comorbid conditions, because we believed distance might be associated with increased mortality for a specific subgroup of patients who lived in isolated areas and had a greater burden of illness. All analyses were performed using SAS Version 9.2.3 (SAS Institute, Cary, NC, USA).

Results

Patients living in small and large rural areas traveled substantially farther than urban patients to get to the treating hospital (Table 3). The mean distance that patients from small rural areas had to travel to the treating facility was greater ($p < 0.001$) than that for patients from urban areas: 34.4 versus 9.3 miles, respectively. Greater than 99% of patients with hip fractures lived within 50 miles from any hospital and 95% of patients lived within 50 miles of the hospital where their fracture was treated. In many cases, patients bypassed a hospital in closer proximity to their place of residence before being admitted to a more distant treating hospital. Specifically, patients in small rural areas bypassed a greater number of closer hospitals ($p < 0.001$) than patients from large rural and urban areas: 65.5% of small rural, 30.0% of large rural, and 47.3% of urban patients.

Unadjusted mortality rates were similar for small rural, large rural, and urban patients (Table 4). The mortality rates were higher for rural patients for 30-day mortality ($p < 0.001$) and higher for urban patients for 1-year mortality ($p < 0.001$). In adjusted analyses using GEEs, mortality differences were again small with rural patients having modestly higher in-hospital mortality but moderately

Table 3. Distances to nearest and treating hospitals by location of residence

Distance	Patient residence			p value*
	Small rural (n = 48,583)	Large rural (n = 45,521)	Urban (n = 243,988)	
Distance to admitting hospital, mean (median, Q1–Q3)	34.4 (27.2, 15.8–43.5)	14.5 (4.1, 0–17.3)	9.3 (4.7, 2.2–9.1)	< 0.001
Distance to nearest hospital, mean (median, Q1–Q3)	15.2 (14.1, 4.1–21.6)	4.1 (0, 0–7)	4.0 (2.9, 0–5.5)	< 0.001
Bypassing nearest hospital, number (%)	31,815 (65.5)	13,497 (30.0)	115,331 (47.3)	< 0.001

* Chi square test was used for categorical data, and ANOVA was used for continuous data; Q = quartile.

Table 4. Unadjusted outcomes by location of residence

Outcome	Patient residence			p value*
	Small rural (n = 48,583)	Large rural (n = 45,521)	Urban (n = 243,988)	
Days from admission to surgery, [†] number (%)				< 0.001
0	12,506 (27.3)	11,074 (25.8)	53,860 (23.4)	
1	22,128 (48.2)	20,696 (48.2)	106,773 (46.3)	
2	6972 (15.2)	6804 (15.9)	41,667 (18.1)	
3+	4291 (9.4)	4341 (10.1)	28,126 (12.2)	
Mean (median, Q1–Q3)	1.2 (1, 0–2)	1.2 (1, 0–1)	1.3 (1, 1–2)	< 0.001
Length of stay, mean (median, Q1–Q3)	5.9 (5, 4–7)	6.0 (5, 4–7)	6.2 (5, 4–7)	< 0.001
Discharge destination, number (%)				< 0.001
Acute care hospital	790 (1.6)	572 (1.3)	1667 (0.7)	
Home	4551 (9.4)	4169 (9.2)	19,720 (8.1)	
Skilled nursing facility	25,744 (53.0)	25,851 (56.8)	145,771 (60.0)	
Rehabilitation facility	8856 (18.2)	9465 (20.8)	57,496 (23.6)	
Other	7157 (14.7)	3992 (8.8)	12,254 (5.0)	
Dead	1485 (3.1)	1472 (3.2)	7080 (2.9)	
Mortality, number (%)				
In-hospital	1485 (3.1)	1472 (3.2)	7080 (2.9)	< 0.001
30-day	3694 (8.2)	3791 (8.3)	19,596 (8.0)	0.09
1-year	13,153 (27.1)	12,601 (27.7)	68,507 (28.1)	< 0.001

* Chi square test was used for categorical data, and ANOVA was used for continuous data; [†]18,854 patients did not have the date of surgery; Q = quartile.

Table 5. Adjusted outcomes for patients from small rural and large rural areas relative to patients from urban areas*

Outcome	Small rural		Large rural	
	Odds ratio (95% confidence interval)	p	Odds ratio (95% confidence interval)	p value
In-hospital	1.05 (0.97–1.14)	0.24	1.13 (1.04–1.23)	0.01
30-day	0.96 (0.91–1.02)	0.19	1.04 (0.99–1.11)	0.15
1-year	0.93 (0.90–0.96)	< 0.001	0.96 (0.93–0.99)	0.03

* Multivariable logistic regression models controlled for patient characteristics including patient age, race, gender, whether the patient had multiple fractures, fracture type, zip code-level income, zip code-level percent of high school graduation, patient comorbidities; and hospital characteristics including hospital geographic location (small rural, large rural, and urban), number of beds, nurse staffing ratio, and distance from patient zip code of residence to the admitting hospital and distance from patient zip code of residence to the nearest hospital.

lower 1-year mortality compared with urban patients (Table 5).

The majority of patients were treated within 2 days of admission to the treating hospital regardless of residence. We did not find an identifiable delay after admission associated with patients residing in rural areas.

The LOS was nearly identical from a clinical perspective for patients from small rural, large rural, and urban areas. Rural patients were more likely ($p < 0.001$) to be discharged home than urban patients.

In the sensitivity analyses for patients living 50 to 100 miles from the nearest hospitals and for patients with two or more comorbidities, the results were close to those in the main analyses and thus are not reported here.

Discussion

Hip fractures are a common injury in the elderly population, typically requiring hospital admission and surgical

intervention. Using contemporary Medicare data, we investigated patients residing in rural areas as a potential population at risk of increased mortality owing to the relative scarcity of medical facilities. We therefore asked whether rural patients with hip fractures (1) traveled farther distances to receive treatment than urban patients, and if the distance traveled correlated with (2) increased mortality, (3) increased delays in time to surgery, or (4) increased hospital LOS.

There are some limitations to this study that merit mention. First, our cohort was limited to Medicare beneficiaries, and extrapolation to a population outside this must be made with caution. Hip fractures are viewed as a quintessential orthopaedic injury of the Medicare population. Second, we were unable to evaluate differences in prehospital care that rural and urban patients might have received. In particular, we lacked data from hospital emergency departments and thus might not have fully captured whether rural patients with hip fractures might have received treatment in a local emergency department before being admitted to a more distant hospital. This limits our ability to definitively measure delays before surgery and is an important avenue for future research. Third, we lacked detailed clinical information regarding the functional status and quality of life that are unarguably important.

Rural residents typically traveled farther than their urban counterparts to receive treatment for a hip fracture. Although this confirms an intuitive assumption, the magnitude of the difference is not as great as might be anticipated. The mean distance small rural patients traveled was 34.4 miles, corresponding to an estimated transit time of one hour [22]. Although the standard of care is to treat hip fractures as soon as possible, a delay of presentation on the scale of hours is unlikely to make a difference in mortality or LOS [20, 23, 26, 27, 29, 30]. We cannot comment on the effectiveness of emergency response mechanisms and triage for patients with hip fractures from rural areas. However, our data show that approximately half of the residents of small rural towns are within 30 miles, or 1 hour's drive, of a hospital equipped to provide definitive treatment.

We found mortality rates for rural and urban patients to be similar. There were minor statistical differences between rural and urban patients for in-hospital and 1-year mortality. These were small differences and it is unclear if they are truly clinically relevant. However, these discrepancies might be attributable to unmeasured differences in patient severity or variations in quality of in-hospital or postdischarge care. There has been longstanding concern that rural populations, because of reduced access to specialists, might experience an increase in mortality when compared with urban populations [11, 21, 24]. Several

studies suggest similar outcomes for rural patients with an array of medical conditions, including ischemic heart disease and diabetes [1, 2, 12]. Alternatively, there are concerns regarding how the limited availability of surgical specialists in rural areas might impact outcomes in emergent conditions such as trauma or hip fracture when the time to presentation and treatment is important. This issue was highlighted in an article by Hsia and Shen [15] (with a comment by Dimick [10]), who reported that more than 38 million Americans did not have access to a trauma center within a 1-hour drive. Our investigation suggests that although rural patients with fractures do need to travel farther, they do not appear to have worse outcomes because of this need to travel.

Our finding that rural patients did not experience a greater delay between admission at the treating hospital and operative management when compared with urban patients is important. The benefit of early presentation and definitive treatment of patients with hip fractures is well established, although a critical time to treatment remains unclear [20, 23, 26, 27, 29, 30]. Given the increased distance that rural patients must travel, one may expect a greater delay among rural patients, but we did not find this to be the case. One reason may be that the increased distance rural patients travel is not clinically relevant. Except for the small percentage of extremely isolated residents, the majority of patients live close enough to an appropriate facility to be able to reach it in a timely manner. An additional explanation is that emergency medical services and triage systems work as designed so no such delay exists. Another possibility is that our measurement does not fully capture all delays that patients experience. In particular, we defined delay as the time between hospital admission and surgical treatment; we were unable to capture prehospital delays that might have occurred before admission. Thus, we believe further evaluation of potential differences in treatment delays be considered.

Hospital LOS was not increased for rural patients. Delays in surgery (on the scale of days) and underlying patient health are factors that can influence the LOS [29]. However, it is unlikely that the location of a patient's residence alone is a contributing cause. We also found that rural patients are more likely to be discharged home, which might be a statement of the general overall health of these patients, less expectations of admission to rehabilitation or care facilities, greater physical help from family members at home, or less access to appropriate rehabilitation or care facilities.

We found that, although rural patients with hip fractures traveled greater distances to receive surgical treatment than their urban counterparts, the mortality rates were similar. These findings should be reassuring to patients, providers, and policymakers that the current delivery system functions adequately for nonlife-threatening orthopaedic trauma.

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