# Treatment and Survival among Elderly Americans with Hip Fractures: A Population-Based Study

## ABSTRACT

*Objectives.* This study was undertaken to examine the patterns of treatment and survival among elderly Americans with hip fracture.

*Methods.* A 5% national sample of Medicare claims was used to identify patients who sustained hip fractures between 1986 and 1989. In comparing treatment patterns across regions, direct standardization was used to derive age- and race-adjusted percentages. Logistic regression and Cox regression were used to examine short- and long-term survival.

*Results.* In the United States, 64% of femoral neck fractures were treated with arthroplasty; 90% of pertrochanteric fractures were treated with internal fixation. Higher short- and long-term mortality was associated with being male, being older, residing in a nursing home prior to fracture, having a higher comorbidity score, and having a pertrochanteric fracture. Blacks and Whites had similar 90-day postfracture mortality, but Blacks had a higher mortality later on. For femoral neck fracture, internal fixation has a modestly lower short-term mortality associated with it than arthroplasty has.

*Conclusion.* Variation in the treatment of hip fracture was modest. The increased delayed mortality after hip fracture among Blacks requires further study. (*Am J Public Health.* 1994;84:1287–1291)

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## Introduction

More than 200 000 hip fractures occur annually in the United States,[1,2] with appreciable associated morbidity and mortality. Despite the human and economic burden of these fractures, relatively little is known about the patterns of treatment or of survival following different treatments.

Although several studies have identified factors related to postfracture survival,[3–6] their results may not be generalizable for several reasons. For example, patient characteristics and surgical practice may vary from one institution to another. The limitations of sample size, the difficulties in comparing crude mortality rates, and the differences in the criteria used to determine treatments further hamper interpretation. To overcome these limitations, we used a 5% sample of national Medicare claims to examine the patterns of treatment for hip fracture and of survival following the most commonly used procedures.

## Methods

### Identification of Cases

The 5% national Medicare claims database was searched for evidence of hip fracture during the years 1986 to 1989. Both hospital (Part A) and physician (Part B) claims were used. A patient was identified as having an acute hip fracture if he or she had a discharge diagnosis of hip fracture (*International Classification of Diseases,* 9th edition [ICD-9] codes 820.0 to 820.9) or if there was a physician claim indicating a treatment for hip fracture (current procedure terminology [CPT] codes in the range 27230 to 27248). A detailed algorithm for case identification

has been described elsewhere[7] and can be obtained from the authors. Patients were excluded from analysis if there was evidence of bone or metastatic cancer, fractures of the femoral shaft or pelvis, or surgery for previous hip fracture. In addition, patients were excluded if they were under age 65, not resident in the United States, or likely to have incomplete claims data because they were not enrolled in both Medicare Parts A and B, were enrolled in a health maintenance organization (HMO), or were receiving coverage through railroad board entitlement.
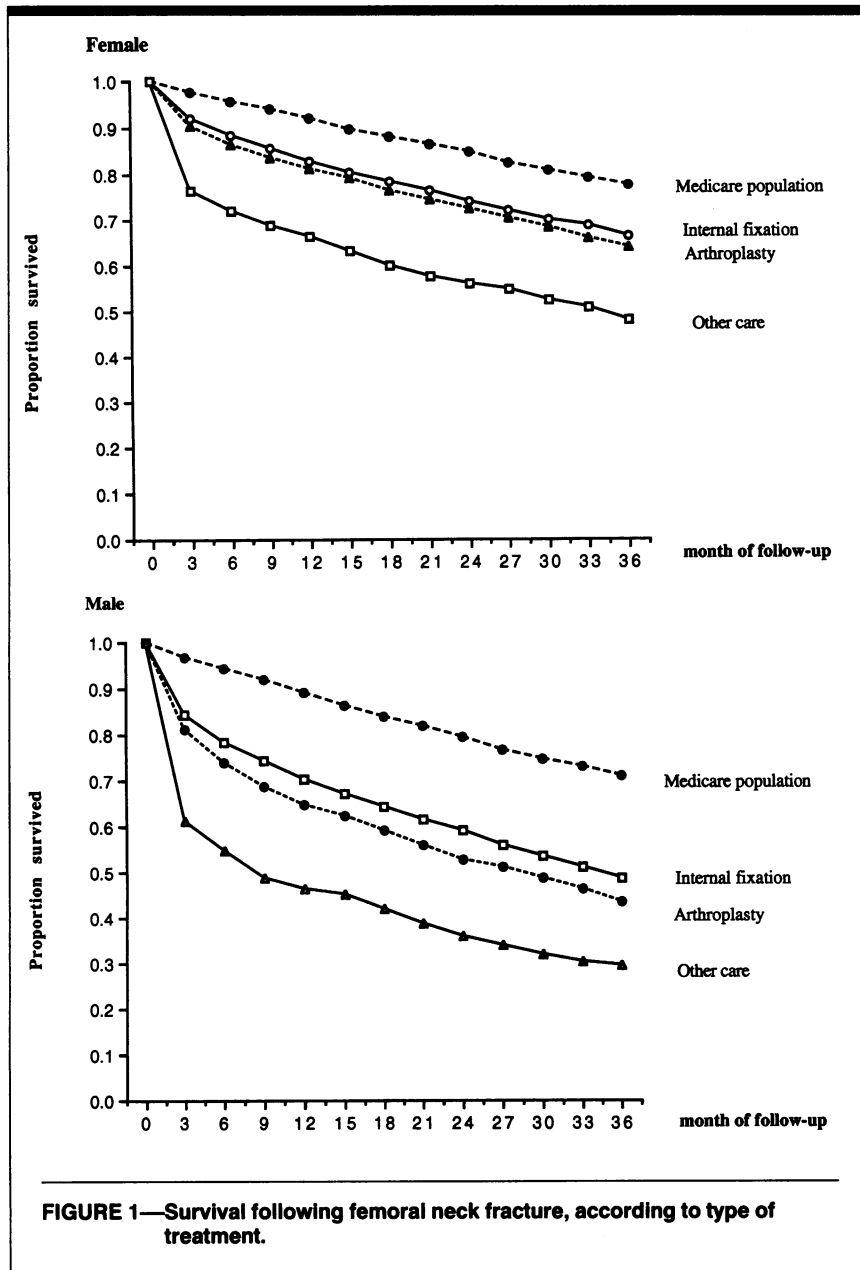
### Definitions of Variables

The site of fracture and treatment were determined from the ICD-9 diagnosis and procedure codes on the hospital claims and from the CPT procedure codes on the physician claims. Fractures were designated as occurring either at the femoral neck or at another site ("pertrochanteric fractures"). Patients receiving internal fixation could be uniquely identified, but since the claims coding could not reliably distinguish between unipolar hemiarthroplasty, bipolar hemiarthroplasty, and total hip replacement, these procedures were grouped together as "arthroplasty." Patients for whom neither

**FIGURE 1—Survival following femoral neck fracture, according to type of treatment.**

dence, analyses were restricted to patients with hip fractures occurring between July 1, 1986, and June 30, 1989.

### Statistical Analysis

In the investigation of geographic variations in treatment, age- and sex-adjusted proportions of patients receiving a given treatment were calculated for each census division and fracture type, using direct standardization with all patients of the fracture type as the standard population.[10] Logistic regression was used to examine the association between patient characteristics and treatment choice.[11] The reference group (Medicare population) shown in Figure 1 provides a representative survival experience of all those in the 5% Medicare sample at the end of 1987 (midpoint in our time period), with the same sex/race/age structure and inclusion criteria as those for the femoral neck fracture patients. The duration of survival postfracture was calculated from the date of the admission for the hip fracture to the date of death or to December 31, 1990. To distinguish early deaths that might be associated with the treatment, separate analyses were conducted for mortality within 90 days and for survival experience beyond 90 days, using logistic regression[11] and Cox proportional hazards regression,[12] respectively. For the latter, log-log plots of all variables were used to assess the proportional hazards assumptions. To examine whether the effect of treatment on survival varied with time in the Cox regressions, separate proportional hazards models were fitted for several follow-up periods, and the statistical significance of the interaction term between treatment and the logarithm of follow-up time was tested.[12] Because no evidence of time-varying effects beyond 3 months post–hip fracture was found, only the overall relative risks for the late survival analyses are presented.

Covariates included in the models were age, sex, race, prefracture residence, comorbidity, site of fracture, and treatment. To account for the effect of comorbidity, two analytical approaches were used: one included exact comorbidity score in the model, and the other used dichotomized comorbidity status (low comorbidity [Charlson score = 0] vs high comorbidity [Charlson score > 0]). Because both approaches gave very similar results, only the model with dichotomized comorbidity status is presented.

internal fixation nor arthroplasty were coded were considered together as a third treatment category ("other care"). Both hospital and physician claims were used to clarify ambiguity or compensate for missing data from any one source. However, because the accuracy of the hospital claims coding has been investigated and found to be excellent for hip fracture,[8] the hospital designation was used in those cases in which the hospital and physician claims disagreed.

Medicare enrollment status, date of birth, sex, race, residence, vital status as of December 31, 1990, and date of death (if any) were obtained from the Health Care Financing Administration denominator files for 1986 to 1990. A comorbidity score

based on the presence or absence of a range of diagnoses recorded in the hospital claims filed for the fracture hospitalization or for hospitalizations during the 6 months prior to hip fracture was calculated using our adaptation[7] of the method described by Charlson et al.[9] A patient was identified as being a nursing home resident if his or her Part B physician claims indicated at least one physician visit occurring in a nursing home in the 3 months preceding the hip fracture. (Federal regulations for skilled and intermediate care facilities require at least this frequency of physician visits for certification.) Since only those who fractured a hip after July 1, 1986, had adequate information on comorbidity and prefracture resi-

**TABLE 1—Characteristics of Patients, by Site of Fracture and Treatment**

| | Femoral Neck Fracture (n = 13 167) | | | Other Hip Fracture (n = 13 267) | | |
|---|---|---|---|---|---|---|
| | Internal Fixation (n = 3569) | Arthroplasty (n = 8458) | Other Care (n = 1140) | Internal Fixation (n = 11 935) | Arthroplasty (n = 417) | Other Care (n = 915) |
| Sex[a]: female, % | 77.9 | 80.1 | 73.7 | 78.6 | 76.3 | 74.5 |
| Race[a] | | | | | | |
| White, % | 95.1 | 94.6 | 91.8 | 95.3 | 94.2 | 94.1 |
| Black, % | 3.6 | 3.6 | 5.4 | 2.9 | 3.8 | 4.5 |
| Age[b]: mean, y | 80.2 ± 0.1 | 81.1 ± 0.1 | 81.6 ± 0.2 | 82.2 ± 0.1 | 81.8 ± 0.4 | 82.1 ± 0.3 |
| Prefracture residence[a]: nursing home, % | 17.3 | 16.1 | 26.0 | 19.6 | 17.0 | 22.1 |
| Comorbidity[b]: mean score | 0.68 ± 0.02 | 0.65 ± 0.01 | 0.77 ± 0.03 | 0.67 ± 0.01 | 0.61 ± 0.05 | 0.83 ± 0.04 |

[a]The entries in the table indicate the percentage of patients with certain characteristics among those who have the same site of fracture and treatment.
[b]The entries in the table are the mean and the standard error of the mean.

## Results

### Case Population

We identified 31 467 candidate hip fracture cases that occurred between July 1, 1986, and June 30, 1989. From those, we excluded 2260 patients who were under age 65, or not resident in the United States, who had evidence of cancer or previous hip surgery, or who had insufficient evidence of hip fracture. Another 2433 patients were excluded because they were not enrollees of both Medicare Parts A and B, were members of HMOs, or were railroad board enrollees. Another 340 cases had multiple hip fracture sites. The remaining 13 167 femoral neck fractures and 13 267 pertrochanteric fractures constituted the basis for this report.

The majority of patients with hip fractures were White women over age 80 (Table 1). Femoral neck fractures and pertrochanteric fractures occurred at similar frequency, but the average age at pertrochanteric fracture was slightly higher than that at femoral neck fracture. The great majority of hip fractures were treated with internal fixation or arthroplasty. Patients treated with other care were more likely to be nursing home residents and to have a higher comorbidity score (Table 1).

### Factors Associated with Surgical Treatments

More than half of the femoral neck fractures were treated with arthroplasty (8458/13 167), whereas most pertrochanteric fractures were treated with internal fixation (11 935/13 267) (Table 1). Geo-

graphic variation in treatment patterns for both types of fracture was modest. The age- and sex-adjusted proportion of femoral neck fractures treated with arthroplasty ranged from 63% to 68% among the nine census divisions; the adjusted proportion of pertrochanteric fractures treated with internal fixation ranged from 88% to 92%.

Since the great majority of pertrochanteric fractures were treated with internal fixation, the association between patient characteristics and the type of treatment was examined only for femoral neck fractures. Among patients over 65, arthroplasty was more likely to be performed in women, older patients, and those persons not living in nursing homes before hip fracture (Table 2).

### Factors Associated with Mortality

Excess mortality associated with hip fractures was most pronounced in the first several months. The 30-day mortality for men and women was 11% and 6%, respectively, whereas the mortality of an age-matched Medicare population was less than 1%. Taking all patients together, the overall post–hip fracture mortality among Medicare beneficiaries was 7% at 1 month, 13% at 3 months, and 24% at 12 months.

Both short- and long-term mortality were higher among patients who were older, were male, resided in a nursing home, had significant comorbid conditions, or had pertrochanteric fracture (Table 3). After taking these factors into account, there was no significant difference in mortality between Blacks and Whites during the first 90 days postfrac-

**TABLE 2—Patient Characteristics and the Relative Likelihood of Being Treated by Arthroplasty among Those with Femoral Neck Fractures (n = 13 167): A 5% National Sample of Medicare Claims, 1986 through 1989**

| | Odds Ratio[a] | 95% Confidence Interval |
|---|---|---|
| Female | 1.00 | ... |
| Male | 0.84 | 0.77, 0.91 |
| Low comorbidity | 1.00 | ... |
| High comorbidity | 0.95 | 0.88, 1.02 |
| Non–nursing home | 1.00 | ... |
| Nursing home | 0.79 | 0.72, 0.87 |
| White | 1.00 | ... |
| Black | 0.90 | 0.74, 1.08 |
| Other | 1.07 | 0.81, 1.41 |
| Age, y | | |
| 65–69 | 1.00 | ... |
| 70–74 | 1.09 | 0.96, 1.24 |
| 75–79 | 1.20 | 1.06, 1.35 |
| 80–84 | 1.26 | 1.12, 1.42 |
| 85–89 | 1.23 | 1.10, 1.39 |
| 90+ | 1.17 | 1.03, 1.33 |

[a]Adjusted for age, sex, race, comorbidity, and place of residence before fracture.

ture. However, the subsequent mortality was higher in Blacks (rate ratio [RR] = 1.21; 95% confidence interval [CI] = 1.08, 1.36) (Table 3). This pattern was found in all census divisions except New England, which had only 12 Blacks with hip fracture during the study period.

**TABLE 3—The Effects of Various Risk Factors on Mortality after Hip Fracture**

| Risk Factors | 0–90 Days[a] | | 91 Days–3 Years[b] | |
|---|---|---|---|---|
| | Odds Ratio | 95% Confidence Interval | Rate Ratio | 95% Confidence Interval |
| Site of fracture: pertrochanteric/neck fracture | 1.18 | 1.06, 1.30 | 1.08 | 1.02, 1.15 |
| Age: 1-year increase | 1.07 | 1.06, 1.07 | 1.05 | 1.04, 1.05 |
| Sex: male/female | 2.21 | 2.04, 2.40 | 1.65 | 1.57, 1.74 |
| Race | | | | |
| Black/White | 1.01 | 0.83, 1.23 | 1.21 | 1.08, 1.36 |
| Others/White | 0.77 | 0.57, 1.03 | 1.65 | 1.41, 1.94 |
| Comorbidity[c]: high/low | 1.89 | 1.75, 2.04 | 1.74 | 1.67, 1.82 |
| Residence: nursing home/ non–nursing home | 1.39 | 1.28, 1.52 | 1.54 | 1.46, 1.62 |
| Treatment (femoral neck fractures only) | | | | |
| Arthroplasty/internal fixation | 1.21 | 1.06, 1.38 | 1.05 | 0.98, 1.13 |
| Other care/internal fixation | 3.24 | 2.71, 3.87 | 1.31 | 1.16, 1.48 |

*Note.* For both logistic and proportional hazard models, covariates in the model were age (interval width-1 year), sex, race, comorbidity (low and high), prefracture residence, site of fracture, and treatment.
[a]Calculated using logistic regression.
[b]Calculated using Cox proportional hazard regression.
[c]Comorbidity score greater than or equal to 1 was classified as high comorbidity.

Patients with other, unknown, or missing race also had increased long-term mortality compared with Whites.

For patients with femoral neck fractures, patterns of treatment-specific mortality were examined (Table 3, Figure 1). Patients treated with other care suffered higher mortality than those treated with internal fixation or hemiarthroplasty (Figure 1). Patients treated with arthroplasty had a modestly elevated short-term mortality (RR = 1.21, 95% CI = 1.06, 1.38). However, among those who survived 90 days, there was no detectable difference in mortality beyond 3 months post–hip fracture (Table 3).

## Discussion

Based on a national sample of Medicare beneficiaries with hip fracture, we found only modest variation in the treatment across regions and races within the United States. Although there was a difference in post–hip fracture mortality between arthroplasty and internal fixation, the magnitude was small and limited to the first several postfracture months. White patients had the lowest postfracture mortality of the racial groups studied.

Although there appears to be consensus among US surgeons regarding management of femoral neck fractures, the observed treatment pattern differed dramatically from that in some regions of Sweden, where almost all femoral neck fractures receive internal fixation.[13] Because about 75% of femoral neck fractures are displaced,[14] this discrepancy almost certainly reflects differing opinions regarding optimal management for displaced femoral neck fractures.[15,16] These findings underscore this controversy and lend support for an evaluation of the outcomes of these alternative treatments.

The survival patterns we report here are comparable to those in several recently published series: the overall 30-day mortality ranged from 6% to 7% and the 1-year mortality ranged from 22% to 24%.[7,17–19] Several earlier studies have shown better short-term survival in patients with femoral neck fracture than in those with pertrochanteric fractures[5,6,19,20]; however, none of them reached statistical significance, possibly owing in part to limited sample size. Our study confirms that pertrochanteric fracture is associated with an elevated mortality even after adjusting for the effect of age and other risk factors.

It has been reported previously that Blacks have a higher mortality after hip fracture than Whites.[21] We show that these findings are independent of type of fracture and treatment, but only for the long-term mortality following the first 3 months postfracture. Could a difference in the severity of the hip fracture contribute to this difference in survival? Although we did not have information on the degree of trauma, the lack of a mortality differential in the first 90 days suggests that this is unlikely. A more plausible explanation for these long-term differences lies with the factors associated in general with a lower life expectancy among Blacks, such as lower socioeconomic status and limited access to health care.[22]

Our study shows nursing home residents to be less likely to have arthroplasty and more likely to suffer postfracture mortality, associations that were present in all census divisions. It is likely that these findings are owing to the poor health and psychosocial support of nursing home residents. Indeed, when comorbidity is deleted from our regression models, the effect of the nursing home appears substantially stronger. Previous studies have also shown that prefracture health and functional status, as well as psychosocial factors, are associated with outcomes following hip fracture.[23,24]

For femoral neck fractures, patients treated with other care had significantly higher mortality than those treated with arthroplasty or internal fixation. Since almost all patients with hip fractures are treated surgically except those who are severely ill, the elevated mortality among those treated with other care is almost certainly a consequence of patient selection. Survival following internal fixation was slightly better than that following arthroplasty, especially in the first several months postfracture—a finding that is consistent with those of several previous studies.[25–27] These differences could be owing to selection of healthier patients for internal fixation. An alternative explanation is that the higher short-term mortality following arthroplasty may be a consequence of factors such as the longer duration of anesthesia and the greater risk of blood loss during surgery.[26]

The validity of our study depends on the accuracy of the Medicare claims. The possibility of incomplete case ascertainment must be acknowledged, but it is unlikely to have affected our findings materially because hip fracture is among the most reliably coded hospital diagnoses.[8] To further improve the ascertainment, accuracy, and clinical relevance of the data extracted, we used both physician and hospital claims. Moreover, our follow-up was relatively complete. The vital

status of patients was based on Social Security Administration files, which have been found to identify more than 97% of known deaths with a false-positive rate of less than 0.1% among those over age 60.[28]

In summary, this study demonstrates that there is little geographic variation in the treatment for hip fractures within the United States. Differences in mortality between arthroplasty and internal fixation are modest and limited to the short term. Racial differences in survival postfracture seem to reflect general mortality trends. □

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