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The Association of Race, Gender, and Comorbidity With Mortality and Function After Hip Fracture

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Abstract

Background—Few studies of hip fracture have large enough samples of men, minorities, and persons with specific comorbidities to examine differences in their mortality and functional outcomes. To address this problem, we combined three cohorts of hip fracture patients to produce a sample of 2692 patients followed for 6 months.

Method—Data on mortality, mobility, and other activities of daily living (ADLs) were available from all three cohorts. We used multiple regression to examine the association of race, gender, and comorbidity with 6-month survival and function, controlling for prefracture mobility and ADLs, age, fracture type, cohort, and admission year.

Results—The mortality rate at 6 months was 12%: 9% for women and 19% for men. Whites and women were more likely than were nonwhites and men to survive to 6 months, after adjusting for age, comorbidities, and prefracture mobility and function. Whites were more likely than were nonwhites to walk independently or with help at 6 months compared to not walking, after adjusting for age, comorbidities, and prefracture mobility and function. Dementia had a negative impact on survival, mobility, and ADLs at 6 months. The odds of survival to 6 months were significantly lower for people with chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and/or cancer. Parkinson's disease and stroke had negative impacts on mobility and ADLs, respectively, among survivors at 6 months.

Conclusions—The finding of higher mortality and worse mobility for nonwhite patients with hip fractures highlights the need for more research on race/ethnicity disparities in hip fracture care.

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Keywords

Hip fracture; Mobility; Activities of daily living; Mortality

Although hip fractures are more common in older women than men and in whites than nonwhites (1–4), there is considerable variation in the patient population: 20%–30% of hip fracture patients are men (5), about 5% are members of minority groups (1), and about 24% have two or more comorbidities at the time of the fracture.

Unfortunately, few studies have large enough samples of men, minorities, and persons with specific comorbidities to examine differences in their mortality and functional outcomes after hip fracture. With few exceptions (6–8), most studies that examine gender focus on mortality, but not functional status (1,5,9). There are two population-based studies with large subsamples of nonwhites, but the data are from the 1980s and the studies report mortality and not functional status outcomes (1,9). A small study from 1987 with 37 black patients with hip fracture found that these patients were at risk for worse mobility at hospital discharge compared to white patients (10). Finally, few studies have examined the effect of specific comorbidities (e.g., stroke and cancer) on mortality (4) and function after hip fracture.

For this study, we capitalized on common measures among three longitudinal studies of older people who sustained hip fracture (3,11–15) to combine the data sets into one with 2692 patients. Of importance, the new data set is large enough to have substantial subgroups of men, minorities, and persons with specific comorbidities for analysis of survival and functional outcomes after hip fracture. The epidemiology of hip fracture is such that we know the most about outcomes for white women. Our study adds measurement of 6-month outcomes, which is not available in most prior studies that focus on mortality, nor is it available for nonwhites or for hip fracture patients with specific chronic conditions. Our goals are to examine the relationships of race, gender, and comorbidities with mortality and functional status 6 months postfracture and to identify subgroups with poor outcomes that we could consider targeting differently in future clinical and rehabilitation interventions.

Methods

Sample

Data for this study are pooled from three longitudinal studies of hip fracture patients that prospectively investigated processes and outcomes of hip fracture care: The Mount Sinai (MS) cohort (3,11); The Baltimore Hip Studies (BHS) cohort (12); and The Hospital for Joint Diseases (HJD) cohort (13–15). The MS cohort includes 1177 hip fracture patients, 50 years old or older, recruited from four hospitals in metropolitan New York City between August 1997 and December 1999. The BHS cohort includes 629 hip fracture patients 65 years old or older, admitted from the community to one of eight Baltimore area hospitals between January 1990 and June 1991 (12). The HJD cohort includes 886 hip fracture patients, 65 years old or older, admitted with hip fracture to the Hospital for Joint Diseases in New York City between 1987 and 2001 (13–15). Patients were followed for a minimum of 6 months in all three studies.

The specific inclusion/exclusion criteria were similar in all three studies and have been previously described (3,12,13). The differences were as follows: The MS cohort included patients 50 years old or older; the other two sites restricted their sample to persons 65 years old or older. About 95% of patients in the pooled data were 65 years old or older. Only MS included patients admitted from nursing homes; and only MS excluded patients with

bilateral fractures, isolated pelvic or acetabular fracture, and multiple trauma. Together, these exclusionary criteria account for 2.6% of patients in our sample. Lastly, only HJD excluded patients who were not cognitively intact. Consequently, the key differences in exclusion criteria were the absence of nursing home residents from the HJD and BHS cohorts and of patients with cognitive impairment from the HJD cohort.

Measures

Outcomes—The numerous methods in common for data collection across the three studies have been described in detail in earlier articles (3,12,13,16). Data on mobility and other basic activities of daily living (ADLs) were available from all three cohorts for the prefracture and 6-month postfracture follow-up. MS collected information on walking and other aspects of functional status using the 13-item motor domain of the Functional Independence Measure (FIM) (17). BHS collected information on mobility using a group of questions derived from the Functional Status Index (18). Walking was measured as part of a battery of questions on basic ADLs (BADL) and mobility (19,20) for patients in the HJD cohort. All three studies collected information on functional status by using a trained interviewer to interview the patient or proxy.

To measure mobility using the items collected from the combined cohorts, we developed a three-category walking variable: independent (walks independently), limited independence (needs human assistance or supervision to walk 150 feet or one block or able only to walk indoors or with a device) and unable to walk.

We used the items from the three cohorts to derive a common dichotomous (independent or not) ADL measure for each of the following activities: (a) feeding, (b) bathing, (c) dressing, and (d) toileting. To accomplish this for the dressing item in the MS and BHS cohorts, we used two separate questions on dressing above the waist and dressing from the waist down, and then combined the responses so that patients who were dependent in one or both questions were considered dependent. To be considered independent, patients had to be independent in both. We treated participants as independent in the particular ADL if they were totally independent or used a device to complete the task. If they were unable to do the task without personal assistance, they were categorized as dependent. We summed the number of independent ADLs to yield a three-category variable: (i) independent in 0 activities, (ii) independent in 1 or 2 activities, or (iii) independent in 3 or 4 activities.

Predictors—All three studies collected demographic factors by using a trained interviewer to interview the patient or proxy. The demographic variables collected in all three cohorts included: gender, age, and whether the patient was white or nonwhite. The nonwhite group included patients who were African American, Hispanic, or of another race/ethnicity category. The proportion of Hispanic patients and persons who fit in the other race/ethnicity category was too small to analyze separately. In addition, some prefracture health status factors were collected from patients' medical records. These included fracture type (femoral neck vs intertrochanteric), dementia, and the presence of comorbidities (angina, congestive heart failure [CHF], myocardial infarction [MI], arrhythmia, hypertension, chronic obstructive pulmonary disease [COPD]/ asthma), diabetes, stroke, cancer, and Parkinson's disease).

We compared the MS and HJD responses of 82 participants who were enrolled in both studies and answered all questions for both studies at all time periods. Thus, we were able to test agreement on several demographic (race, living situation) and health and functional status characteristics (comorbid conditions and feeding, bathing, dressing, and toileting independence) for MS and HJD. The κ statistics on agreement between the MS and HJD variables for the same participants ranged from .48 to .92, which is consistent with moderate

to excellent agreement (21). We dropped variables from analysis when the data were not comparable between the two data sets. Unfortunately, there were no cases shared between BHS and the other cohorts. However, the methods and procedures of data collection were similar between the MS and BHS cohorts.

The study protocol was reviewed and approved by the institutional review boards at the Mount Sinai School of Medicine, University of Maryland at Baltimore, and Hospital for Joint Diseases.

Analyses

We used a series of regression analyses to examine the association of race, gender, and comorbidity with 6-month survival and function, controlling for prefracture mobility and ADLs, age, fracture type, cohort, and admission year (to control for unmeasured practice pattern differences and changes).

Survival—We used a multivariable logistic regression of survival at 6 months rather than survival analysis because date of death was not available for a substantial portion of the sample. The predictors included the key variables (being male and being white) and the following comorbidities: angina, CHF, MI, arrhythmia, hypertension, COPD/asthma, diabetes, stroke, cancer, dementia, Parkinson's disease, and age (<75, 75–84, >84). We adjusted for cohort (MS, BHS, HJD), fracture type, and admission year (1988–89, 1990–92, 1993–95, 1996–98, 1999–2000).

Mobility at 6 months—We used a generalized, ordered logistic model (GOLM) to examine the association of race, gender, age, and comorbidity with 6-month mobility, controlling for cohort, fracture type, and admission year. The dependent variable was categorized as (a) independent walking, (b) limited independence, or (c) inability to walk. GOLM was required because the dependent variable was categorical and ordered but did not satisfy the assumption of a constant odds ratio for all categories (22).

ADLs at 6 months—We also used a GOLM for the same reason to analyze the relationship of race, gender, age, and comorbidity with 6-month ADLs, controlling for cohort, fracture type, and admission year. The dependent variable was categorized as (a) independent in 0 activities, (b) independent in 1 or 2 activities, or (c) independent 3 or 4 activities.

Results

Characteristics of the Sample

Table 1 presents descriptive characteristics of the sample at baseline. The sample was predominately female, white, and independent in mobility and ADLs before the fracture. The mean number of comorbid conditions per participant was 1.6 (standard deviation = 1.3), and hypertension was the most prevalent comorbidity (47%).

Race, Gender and Comorbidity Effects on 6-Month Outcomes

The overall mortality rate at 6 months was 12%: 9.7% for women and19.2% for men. Table 2 shows the predictors of patient survival at 6 months. Whites and women were more likely than were nonwhites and men to survive 6 months. The odds of survival to 6 months were also significantly lower for people with CHF, COPD, or cancer.

Tables 3 and 4 show the associations of race, gender, and comorbidities with mobility and ADLs, respectively, at 6 months controlling for age, prefracture mobility and function,

admission year, and cohort. Whites were more likely than were nonwhites to walk independently or with help (limited independence) at 6 months compared to not walking at all at 6 months. However, gender was not associated with mobility (Table 3) or ADLs (Table 4) among survivors at 6 months. Race was not associated with ADL independence at 6 months among survivors (Table 4).

Dementia had a negative impact on survival, mobility, and ADLs at 6 months after hip fracture. The comorbidities that affected functional outcomes in addition to dementia were arrhythmia, stroke, and Parkinson's disease. In all cases, the comorbidities decreased the odds of independence in walking (Table 3) or ADLs (Table 4) among survivors at 6 months.

Other factors independently and significantly associated with survival, mobility, and ADL independence included prefracture mobility and ADL independence. Specifically, people who were independent in ADLs before the fracture were about 1.8 times as likely (95% confidence interval [CI], 1.32–2.50) to survive as were those who were not independent. Similarly, people who walked independently before the fracture were almost twice as likely to survive to 6 months as those who did not walk independently.

Discussion

Whites had a lower mortality risk than did nonwhites after hip fracture. Moreover, among surviving patients, there was an advantage in mobility at 6 months for white patients with hip fracture compared to nonwhites. Of importance, the mortality and mobility advantage for whites remained even after controlling for prefracture mobility and function, age, comorbidity, and type of fracture.

Race/ethnicity effects on mortality and morbidity after hip fracture have not been well explored. Two studies using data from the 1980s found that black patients with hip fracture had higher mortality than their white counterparts (1,9). Our study, which used more recent data, confirms the higher mortality risk for nonwhites. Race/ethnicity differences in survival and functional status outcomes could be due to treatment disparities. It has been reported that black patients with hip fracture were less likely to receive high-intensity rehabilitation in the hospital (23) and were more likely than whites to receive more limited or no postacute physical therapy after hip fracture (24). Additionally, unmeasured factors such as severity of comorbid conditions may contribute to the mortality differences. Further research that over-samples minorities is needed to look for multiple sources of race/ethnicity differences in hip fracture outcomes.

Male gender was a risk factor for mortality at 6 months after hip fracture after adjustment for age, comorbidity, prefracture mobility and functional status, and type of fracture. Among surviving men and women, no differences in postfracture mobility or ADL limitations were found. Dementia was the only comorbidity with a negative effect on survival as well as on mobility and ADL independence. CHF, COPD, and cancer had negative effects on survival, but not function, whereas stroke, arrhythmia, and Parkinson's disease did not influence survival, but reduced the odds of independent mobility and ADLs at 6 months after fracture.

Our finding of an increased mortality risk for men with hip fracture is consistent with several previous studies (1,5,8,9,25–27), and the survival advantage for women persists for several years (1,5). However, there is no strong explanation for the gender difference in mortality after hip fracture. A recent study by Wehren and colleagues (5) posited that men's health was more unstable at the time of fracture, making them vulnerable to postfracture mortality from infections (pneumonia, influenza, and septicemia). Severity of comorbid conditions was not measured in the present study or in previous studies, and it may play a

role in mortality differences between men and women. Additionally, treatments designed primarily from research on women hip fracture patients may not apply as well for men.

Among surviving men and women, no gender differences in postfracture mobility or ADL limitations were found despite a sample with more than 2000 observations. Thus we have confirmed the findings of several earlier studies with considerably smaller samples of men with hip fracture (6,26,28). It is possible that those who survive the initial postfracture period will be similar with regard to factors that affect functional status in the later postfracture period. The gender difference in survival, but not functional status outcomes, requires further study.

Previous studies have shown that comorbidities have a negative effect on survival (1,29) and functional status outcomes (1,13,26,30) for people with hip fracture. In this study, we were able to identify specific conditions that affected mortality and function or one but not the other. Dementia was the only comorbid condition with a significant negative effect on survival, mobility, and ADL independence. This finding is consistent with those of a recent study showing prefracture cognitive impairment and incident cognitive impairment during hospitalization as risk factors for poor functional outcomes after hip fracture (31) and as risk factors for mortality (32). Patients with advanced dementia and hip fracture have been shown to have a poor prognosis (33).

CHF, COPD, and cancer significantly decreased the odds of survival to 6 months but did not have a significant impact on function. In contrast, cerebrovascular accident and Parkinson's disease decreased the odds of independent mobility and ADLs at 6 months but had an insignificant association with mortality. The functional effects of stroke or Parkinson's disease may be due to the direct and consistent impact of these conditions on strength and mobility. In contrast, COPD, CHF, and cancer are likely to have more variable effects on the strength and mobility necessary for ADL performance.

The validity of our results must be considered in light of limitations of the study. First, these findings are based on a secondary analysis of three hip fracture data sets with differences in measures and sample characteristics. However, the three studies had almost identical methods of case ascertainment, baseline data collection methods, and follow-up strategies at 6 months postfracture. Additionally, the comparability of demographic, comorbidity, and functional status variables for a subsample of 82 participants enrolled in both the MS and HJD cohorts were compared and were found to have moderate to excellent agreement with one another. In all three cohorts, comorbidities were ascertained from medical records. Thus, some may have been under-reported, for example, dementia.

An important limitation to the findings about nonwhites is that our data limited us to one large category of all nonwhites. In fact, Harada and colleagues (24) found that both blacks and those of "other" races—including Latino, Asian, Pacific Islander, and Native American—were less likely than whites to receive acute physical therapy after hip fracture. These data show the effect of other races as a group independent of African Americans and raise the question of whether further distinctions among groups would provide more information on race/ethnicity effects.

Despite these limitations, the present study makes several contributions to the literature on hip fracture outcomes. First, higher mortality and worse mobility for older nonwhite patients with hip fracture was demonstrated, highlighting the need for more research on race/ethnicity disparities in hip fracture care. Second, no gender effect on mobility or ADLs in a sample with more than 2000 hip fracture patients was observed, and a higher mortality rate for men was confirmed. Last, specific conditions that affected mortality and function or one outcome but not the other were identified. The disparities in outcomes reported in this large

cohort of hip fracture patients warrants further inquiry into the reasons for differences observed and whether these disparities can be reduced through prefracture and postfracture management practices and treatments.

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Table 1

Baseline Characteristics of the Hip Fracture Sample (N = 2692)

Characteristics	Percent (N)
Male	21 (568)
White	92 (2477)
Age, y	
<75	20 (538)
75–84	43 (1158)
85+	37 (996)
Fracture type	
Femoral neck (versus intertrochanteric fracture)	49 (1314)
Dementia present	14 (382)
Number of independent ADLs before fracture	
0	9 (242)
1 or 2	15 (404)
3 or −4	76 (2046)
Walking ability before fracture *	
Unable	4 (108)
Limited independence (walks with help or device)	47 (1267)
Independent walking	48 (1283)
Comorbidities	
Hypertension	47 (1254)
Arrhythmia	16 (416)
Diabetes	14 (363)
Cancer	13 (354)
COPD/Asthma	12 (333)
CHF	11 (309)
Angina	10 (281)
MI	10 (269)
CVA/Stroke	10 (264)
Parkinson’s disease	6 (150)
Cohort	
MS	44 (1177)
BHS	23 (629)
HJD	33 (886)
Year of data	
1987–1989	12 (333)
1990–1992	33 (899)
1993–1995	8 (216)
1996–1998	32 (840)
1999–2000	15 (404)

Notes:

*Walking categories are defined as follows: walks with help includes participants who needed human assistance or supervision or a device to walk; walks independently includes those who walked without assistance.

COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure; MI = myocardial infarction; MS = Mount Sinai cohort; BHS = Baltimore Hip Studies cohort; HJD = Hospital for Joint Diseases cohort; CVA = cerebrovascular accident; ADL = activities of daily living.

Table 2

Logistic Regression Analysis of Predictors of Patient Survival 6 Months After Hip Fracture (N = 2692)

Variables	Adjusted OR (95% CI)	*p* Value
Males	0.45 (0.34, 0.60)	<.0001
Whites	1.74 (1.15, 2.65)	.009
Age		
75–84 y	0.67 (0.44, 0.99)	.05
85 y or older	0.49 (0.32, 0.72)	.001
Dementia present	0.65 (0.47, 0.91)	.01
Comorbidities		
Hypertension	1.20 (0.92, 1.57)	.17
Arrhythmia	0.76 (0.55, 1.05)	.10
Diabetes	0.91 (0.64, 1.29)	.58
Cancer	0.49 (0.36, 0.69)	<.0001
COPD/Asthma	0.63 (0.45, 0.90)	.011
CHF	0.55 (0.40, 0.80)	.001
Angina	0.76 (0.52, 1.11)	.16
MI	1.00 (0.63, 1.35)	.67
CVA/Stroke	0.89 (0.61, 1.30)	.54
Parkinson’s disease	0.83 (0.51, 1.35)	.49

Notes: All variables were adjusted for fracture type, walked independently before the fracture versus with personal help, with a device, or not at all; activities of daily living limitations before the fracture; cohort; year of admission.

Reference groups: female; non-white; age <75 years.

OR = odds ratio; CI = confidence interval; COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure; MI = myocardial infarction; CVA = cerebrovascular accident.

Table 3

Generalized Ordered Logistic Regression Analysis of the Association of Race, Gender, and Comorbidity With Independent Walking 6 Months After Hip Fracture: Adjusted Odds Ratios (ORs) With 95% Confidence Intervals (CIs) (N = 2041)

Predictors	Adjusted OR (95% CI) Walks Independently (N = 844) (31%) or Limited Independence (N = 932) (35%) at 6 Months*	p Value	Adjusted OR (95% CI) Walks Independently at 6 Months† (N = 844) (31%)	p Value
Male	1.01 (0.76, 1.44)	.85	0.93 (0.71, 1.21)	.58
White	1.54 (1.01, 2.37)	.05	0.95 (0.64, 1.40)	.77
Age 75–84 years	0.76 (0.52, 1.09)	.13	0.54 (0.40, 0.70)	<.0001
Age 85+	0.69 (0.46, 1.03)	.07	0.46 (0.40, 0.62)	<.0001
Dementia	0.43 (0.30, 0.60)	<.0001	0.65 (0.47, 0.93)	.02
Hypertension	0.99 (0.76, 1.28)	.85	1.02 (0.83, 1.27)	.92
Arrhythmia	0.86 (0.61, 1.19)	.33	0.71 (0.52, 0.98)	.04
Diabetes	0.84 (0.59, 1.18)	.32	0.98 (0.72, 1.33)	.88
Cancer	0.91 (0.62, 1.35)	.66	0.92 (0.67, 1.26)	.61
COPD/Asthma	0.72 (0.50, 1.04)	.08	0.95 (0.69, 1.31)	.75
CHF	0.95 (0.63, 1.42)	.79	1.06 (0.73, 1.55)	.76
Angina	0.92 (0.59, 1.41)	.73	0.73 (0.49, 1.06)	.10
MI	1.11 (0.72, 1.72)	.64	1.22 (0.86, 1.78)	.25
CVA/Stroke	0.73 (0.49, 1.07)	.10	0.78 (0.54, 1.13)	.54
Parkinson’s disease	1.00 (0.58, 1.73)	.99	0.37 (0.22, .66)	.001
Constant	–		–	

Notes: Adjusted for fracture type, walked independently before the fracture versus with personal help, device, or not at all; activities of daily living limitations before the fracture; cohort; year of admission.

*Compared to unable to walk at 6 months (n = 367; 14%)

†Compared to limited independence or unable to walk at 6 months.

COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure; MI = myocardial infarction; CVA = cerebrovascular accident.

Table 4

Generalized Ordered Logistic Regression Analysis of the Association of Race, Gender, and Comorbidity With Independence in ADLs 6 Months After Hip Fracture: Adjusted Odds Ratios (ORs) (95% Confidence Intervals [CIs]) (N = 2012)

Predictors	Adjusted OR (95% CI) for Independence in at Least 1 ADL* (N = 1756; 87.3%)	p Value	Adjusted OR (95% CI) for Independence in at Least 3 ADLs† (N = 1264; 62.8%)	p Value
Male	0.94 (0.63, 1.41)	.77	1.01 (0.76, 1.34)	.94
White	1.53 (0.89, 2.62)	.13	1.20 (0.79, 1.82)	.40
Age 75–84	0.65 (0.40, 1.06)	.08	0.59 (0.43, 0.83)	.001
Age 85+	0.64 (0.39, 1.08)	.10	0.38 (0.27, 0.53)	<.0001
Dementia	0.25 (0.17, 0.36)	<.0001	0.26 (0.18, 0.39)	<.0001
Hypertension	1.01 (0.73, 1.40)	.13	0.89 (0.71, 1.10)	.30
Arrhythmia	0.83 (0.50, 1.28)	.39	0.85 (0.60, 1.18)	.33
Diabetes	0.89 (0.58, 1.37)	.60	0.88 (0.63, 1.22)	.45
Cancer	1.07 (0.65, 1.73)	.19	1.02 (0.73, 1.42)	.91
COPD/Asthma	1.45 (0.85, 2.48)	.17	0.81 (0.58, 1.14)	.18
CHF	1.04 (0.64, 1.71)	.17	0.87 (0.59, 1.29)	.50
Angina	1.09 (0.61, 2.00)	.30	0.92 (0.64, 1.35)	.74
MI	1.45 (0.82, 2.60)	.20	0.97 (0.67, 1.41)	.88
CVA/Stroke	1.09 (0.67, 1.80)	.72	0.48 (0.33, 0.72)	<.0001
Parkinson’s disease	0.79 (0.43, 1.47)	.46	0.65 (0.39, 1.09)	.10
Constant	–		–	

Notes: Adjusted for fracture type, walked independently before the fracture versus with personal help, with device or not at all; activities of daily living (ADL) limitations before the fracture; cohort; year of admission.

*Compared to independent in 0 ADLs at 6 months (N = 256; 12.7%).

†Compared to independent in 0, 1, or 2 ADLS at 6 months (N = 748; 37.2%).

COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure; MI = myocardial infarction; CVA = cerebrovascular accident.