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Relative Mortality in U.S. Medicare Beneficiaries with Parkinson Disease and Hip and Pelvic Fractures

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Investigation performed at Washington University School of Medicine, St. Louis, Missouri

Background: Parkinson disease is a neurodegenerative disease that affects gait and postural stability, resulting in an increased risk of falling. The purpose of this study was to estimate mortality associated with demographic factors after hip or pelvic (hip/pelvic) fracture in people with Parkinson disease. A secondary goal was to compare the mortality associated with Parkinson disease to that associated with other common medical conditions in patients with hip/pelvic fracture.

Methods: This was a retrospective observational cohort study of 1,980,401 elderly Medicare beneficiaries diagnosed with hip/pelvic fracture from 2000 to 2005 who were identified with use of the Beneficiary Annual Summary File. The race/ethnicity distribution of the sample was white (93.2%), black (3.8%), Hispanic (1.2%), and Asian (0.6%). Individuals with Parkinson disease (131,215) were identified with use of outpatient and carrier claims. Cox proportional hazards models were used to estimate the risk of death associated with demographic and clinical variables and to compare mortality after hip/pelvic fracture between patients with Parkinson disease and those with other medical conditions associated with high mortality after hip/pelvic fracture, after adjustment for race/ethnicity, sex, age, and modified Charlson comorbidity score.

Results: Among those with Parkinson disease, women had lower mortality after hip/pelvic fracture than men (adjusted hazard ratio [HR] = 0.63, 95% confidence interval [CI]) = 0.62 to 0.64), after adjustment for covariates. Compared with whites, blacks had a higher (HR = 1.12, 95% CI = 1.09 to 1.16) and Hispanics had a lower (HR = 0.87, 95% CI = 0.81 to 0.95) mortality, after adjustment for covariates. Overall, the adjusted mortality rate after hip/pelvic fracture in individuals with Parkinson disease (HR = 2.41, 95% CI = 2.37 to 2.46) was substantially elevated compared with those without the disease, a finding similar to the increased mortality associated with a diagnosis of dementia (HR = 2.73, 95% CI = 2.68 to 2.79), kidney disease (HR = 2.66, 95% CI = 2.60 to 2.72), and chronic obstructive pulmonary disease (HR = 2.48, 95% CI = 2.43 to 2.53).

Conclusions: Mortality after hip/pelvic fracture in Parkinson disease varies according to demographic factors. Mortality after hip/pelvic fracture is substantially increased among those with Parkinson disease.

Level of Evidence: Prognostic Level III. See Instructions for Authors for a complete description of levels of evidence.

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Parkinson disease is a neurodegenerative disease characterized by bradykinesia, rigidity, resting tremor, and postural instability[1]. With disease progression, postural instability increases, often leading to falls[2,3]. While dopaminergic therapy improves tremor and rigidity, symptoms such as bradykinesia, freezing when walking, and impaired balance may remain, resulting in an increased risk of falls and injury[4,5]. People with Parkinson disease are particularly susceptible to hip fractures[5-7], with a 3.2-fold greater risk compared with the risk for people without Parkinson disease[8]. In addition to gait disturbances and postural instability, other factors such as postural hypotension, decreased bone mineral density[9,10], low vitamin-D levels[11,12], dementia[8], medications[5], and advanced age[8] further increase the fracture risk for people with Parkinson disease.

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TABLE I Demographic Characteristics

Patient Characteristics	Parkinson Disease with Hip Fracture (N = 131,215)	No Parkinson Disease with Hip Fracture (N = 1,849,186)	All with Hip Fracture (N = 1,980,401)
Race/ethnicity* *(no. [%])*			
White	123,769 (94.3)	1,722,622 (93.2)	1,846,391 (93.2)
Black	3632 (2.8)	71,553 (3.9)	75,185 (3.8)
Hispanic	1829 (1.4)	22,087 (1.2)	23,916 (1.2)
Asian	787 (0.6)	11,270 (0.6)	12,057 (0.6)
Sex *(no. [%])*			
Male	45,563 (34.7)	423,355 (22.9)	468,918 (23.7)
Female	85,652 (65.3)	1,426,831 (77.2)	1,512,483 (76.4)
Mean age (standard deviation) *(yr)*	81.0 (7.8)	82.3 (6.6)	82.2 (7.7)
Mean modified Charlson comorbidity score (standard deviation)	6.47 (1.72)	6.30 (1.84)	6.33 (1.84)

*Native American, unknown, and other were not reported due to small numbers of subjects or race ambiguity; therefore percentages do not equal 100.

Among the general population, mortality rates for people with hip fractures are reported to be up to 36% greater compared with the rates in non-hip-fracture reference populations[13]. Although it is clear that hip fracture increases mortality in the general population, less is known about the mortality risk after hip fracture in people with Parkinson disease. Hip fractures are common in Parkinson disease and recovery may be complicated by the disease signs and symptoms. Understanding the comparative mortality associated with hip fracture in patients with and without Parkinson disease may help identify those at higher risk of death and determine specific treatment strategies to reduce that risk.

The goal of this study was to investigate mortality rates associated with demographic and clinical risk factors after hip or pelvic (hip/pelvic) fractures in people with Parkinson disease and compare these rates with postfracture mortality rates among those with other medical conditions. We hypothesized that, similar to what has been found in non-Parkinson disease populations, men with Parkinson disease would have a higher mortality after hip/pelvic fracture than women with Parkinson disease, and that mortality would differ according to race/ethnicity. Finally, we expected patients with Parkinson disease to have greater mortality after hip/pelvic fracture than those without Parkinson disease.

Materials and Methods

This study was approved by the Human Protection Research Office of the Washington University School of Medicine.

Study Population

Beneficiaries with a Medicare part-A or B claim for a hip fracture from 2000 to 2005 were identified from the Medicare Beneficiary Annual Summary File, which contains the date of diagnosis of a hip fracture. In the Medicare Beneficiary Annual Summary File, the diagnosis of hip fracture (hereafter referred to as "hip/pelvic fracture") includes any fracture of the proximal part of the femur, acetabulum, or pelvic ring. The International Classification of Diseases, Ninth Revision (ICD-9) codes representing the hip fracture diagnosis in the Medicare Beneficiary Annual Summary File are provided in the Appendix of this article. The Medicare Beneficiary Annual Summary File also contains twenty-one other common diseases contained in Medicare's Chronic Condition Data Warehouse, as well as demographic and vital status data[14]. Using these data, we identified hip/pelvic fracture cases with the following comorbid diagnoses: chronic obstructive pulmonary disease, stroke/transient ischemic attack, diabetes mellitus, ischemic heart disease, osteoporosis, dementia, heart failure, and chronic kidney disease. Medicare outpatient and carrier claims data were used to identify hip/pelvic fracture cases with comorbid Parkinson disease with use of previously published methods[15,16].

Demographic and Clinical Data

Race/ethnicity (according to standard Medicare race codes), sex, and date of birth were extracted for each subject. Using information from Medicare's Chronic Condition Data Warehouse contained in the Medicare Beneficiary Annual Summary File, we calculated an age-weighted modified Charlson comorbidity score for each case on the basis of the presence of malignant disease (breast, prostate, endometrial, lung, or colon/rectum), ischemic heart disease, diabetes, chronic obstructive pulmonary disease, stroke/transient ischemic attack, acute myocardial infarction, chronic kidney disease, or heart failure[14]. Using specifications documented by Medicare's Chronic Condition Data Warehouse[17], we calculated the Charlson comorbidity score on the basis of the presence of a diagnostic claim made in any inpatient or outpatient setting. The time frames used by the Chronic Condition Data Warehouse are (1) the previous calendar year for malignant disease, chronic obstructive pulmonary disease, stroke/transient ischemic attack, and acute myocardial infarction and (2) the previous two years for ischemic heart disease, diabetes, chronic kidney disease, or heart failure.

Survival Analyses

Survival status was determined by using the 2000 to 2008 Medicare Beneficiary Annual Summary Files with previously published methods[18]. The time-to-event variable was calculated from the date of the hip/pelvic fracture to the recorded date of death (measured in months). Surviving cases were censored at the end of the calendar year in 2008. Covariates included race, sex, age at diagnosis, and modified Charlson comorbidity score. To investigate whether demographic or clinical factors were associated with differential survival after hip/pelvic fracture in people with Parkinson disease, we performed Cox proportional hazard analysis using people with Parkinson disease and hip/pelvic fracture and adjusting for age and modified Charlson comorbidity score. To investigate comparative mortality, we performed Cox proportional hazards analysis comparing mortality of people with Parkinson disease and hip/pelvic fracture with

TABLE II Post-Hip Fracture Mortality Risk Associated with Sex and Race/Ethnicity Among Individuals with Parkinson Disease

	Unadjusted		Adjusted*		
	HR	95% CI	HR	95% CI	P Value
Race/ethnicity					
White	Reference		Reference		
Black	1.00	0.97-1.04	1.12	1.09-1.16	<0.001
Hispanic	0.86	0.81-0.91	0.87	0.81-0.95	0.001
Asian	0.78	0.72-0.85	0.93	0.85-1.02	0.132
Sex					
Male	Reference		Reference		
Female	0.65	0.64-0.66	0.63	0.62-0.64	<0.001

*Adjusted for age and age-weighted modified Charlson comorbidity score, with the race/ethnicity analysis adjusted for sex as well and the sex analysis adjusted for race/ethnicity as well.

mortality of people with hip/pelvic fracture and other common illnesses (dementia, stroke, chronic obstructive pulmonary disease, kidney disease, diabetes, heart failure, ischemic heart disease, and osteoporosis), with hip/pelvic fracture cases without any of these conditions used as the reference group.

Statistical Analyses

Descriptive analyses were performed to compare members of the study population by survival status according to demographic and clinical variables. We used independent t tests to compare means of continuous variables, and we used chi-square tests to compare proportions. Standard methods were used to produce Cox proportional hazard coefficients with 95% confidence intervals (CIs).

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Results

Subject Demographics

The demographic characteristics of the study population are summarized in Table I. Our analysis included 1,980,401 individuals who had sustained a hip/pelvic fracture, 131,215 of whom had Parkinson disease. There were more whites and fewer blacks in the Parkinson disease cohort than in the general hip/pelvic fracture population ($p < 0.001$). While in both groups, the majority of the patients with a fracture were women, 34.7% of the patients with a hip/pelvic fracture and Parkinson disease were men compared with 22.9% of the individuals with a hip/pelvic fracture who did not have Parkinson disease ($p < 0.001$). Those with Parkinson disease were younger and demonstrated a higher modified Charlson comorbidity score than those without Parkinson disease ($p < 0.001$).

Association of Mortality with Sex, Race/Ethnicity

The risk of death after hip/pelvic fracture associated with sex and race/ethnicity among beneficiaries with Parkinson disease are provided in Table II. After adjustments for age, race, and modified Charlson comorbidity score, women had a lower risk of death than men (adjusted hazard ratio [HR] = 0.63, 95% CI = 0.62 to 0.64). Compared with whites with Parkinson disease, blacks with Parkinson disease had higher mortality (adjusted HR = 1.12, 95% CI = 1.09 to 1.16) and Hispanics with Parkinson disease had lower mortality (adjusted HR = 0.87, 95% CI = 0.81 to 0.95). The mortality rates of whites and Asians were similar (adjusted HR = 0.93, 95% CI = 0.85 to 1.02).

Association of Mortality with Medical Condition

The risks of death after hip/pelvic fracture associated with Parkinson disease and other medical conditions are provided in Table III. Among all individuals with hip/pelvic fracture, those with Parkinson disease had a greater risk of death (adjusted

TABLE III Post-Hip Fracture Mortality Risk Associated with Medical Conditions*

	HR*	95% CI	P Value
No documented disease	Reference		
Dementia	2.73	2.68-2.79	<0.001
Kidney disease	2.66	2.60-2.72	<0.001
Chronic obstructive pulmonary disease	2.48	2.43-2.53	<0.001
Parkinson disease	2.41	2.37-2.46	<0.001
Diabetes mellitus	2.37	2.32-2.41	<0.001
Stroke/transient ischemic attack	2.28	2.23-2.34	<0.001
Heart failure	2.28	2.23-2.33	<0.001
Ischemic heart disease	2.17	2.14-2.21	<0.001
Osteoporosis	1.89	1.86-1.92	<0.001

*Adjusted for age, age-weighted modified Charlson comorbidity score, sex, and race/ethnicity.

HR = 2.41, 95% CI = 2.37 to 2.46) than patients without Parkinson disease. Patients with dementia (adjusted HR = 2.73, 95% CI = 2.68 to 2.79), kidney disease (adjusted HR = 2.66, 95% CI = 2.60 to 2.72), or chronic obstructive pulmonary disease (adjusted HR = 2.48, 95% CI = 2.43 to 2.53) had the highest mortality.

Discussion

Despite hip fractures being common in individuals with Parkinson disease[5-7], little is known about the factors associated with the post-hip fracture mortality of these individuals. Similar to what has been found in the general population, men with Parkinson disease demonstrated a higher risk of death than women. We also found that mortality varied across race/ethnic categories, with black patients demonstrating a higher and Hispanic patients demonstrating a lower adjusted risk of death compared with white patients. Finally, we demonstrated that people with Parkinson disease had substantially increased postfracture mortality, suggesting a need for aggressive fracture prevention and coordinated postfracture care for people with Parkinson disease.

A major strength of our study is the large sample size. The sample was obtained with use of the Medicare data set, the only population-based U.S. health-care database, which provides substantial power to detect effects on mortality. We were able to achieve complete case follow-up and adjust for multiple factors, including comorbidities. Additionally, we were able to determine mortality differences based on race/ethnicity, which is often underreported in studies of hip fracture. Finally, Medicare data provide a "real world" demonstration of the impact of hip/pelvic fracture on patients with Parkinson disease, in contrast to specialty center studies that report outcomes on a select and often non-representative population. Our study demonstrates the importance of demographic factors in mortality after hip/pelvic fracture in people with Parkinson disease.

Our findings related to sex are consistent with those of previous studies on mortality following hip fracture in the general population[19-28]. A meta-analysis of mortality following hip fracture surgery demonstrated that men with hip fracture have a higher mortality (pooled HR = of 1.7) than women[27]. The relationship was similar among those with Parkinson disease in our study. It is unclear why men have higher mortality after fracture than women. Previous studies have indicated that men have more comorbidities and more severe comorbidities at the time of fracture[19,20,22-24], but male sex remained a significant risk factor after adjustment for comorbidities in our study and in others[19,20,22-24]. We were unable to adjust for comorbidity severity, postural instability, gait impairments, or postoperative complications due to the limited data available in this administrative data set.

We are the first, to our knowledge, to report on the association between race/ethnicity and mortality after hip/pelvic fracture in people with Parkinson disease. Studies related to race/ethnicity and mortality after hip/pelvic fracture in the general population have shown conflicting results. Jacobsen et al.[28] used Medicare data from 1984 to 1987 to assess the relationship between sex/race pairings and mortality and reported that mortality rates among white and black men were similar, but black women had a higher mortality rate (22.9 of 1000) than white women (17.2 of 1000). Lu-Yao et al.[21] used Medicare data from 1986 to 1989 and reported that, compared with whites, blacks (adjusted odds ratio [OR] = 1.21, 95% CI = 1.08 to 1.36) and patients with other, unknown, or missing race (adjusted OR = 1.65, 95% CI = 1.41 to 1.94) had higher mortality. Penrod et al.[29] also found that whites were more likely to survive (adjusted OR = 1.74, 95% CI = 1.15 to 2.65) after hip fracture compared with nonwhites. Hannan et al.[30] reported greater six-month mortality in nonwhite patients (24%) compared with white patients (13%); however, this difference was not significant. In contrast, Orces and Alamgir[31] reported higher post-hip fracture mortality in whites compared with blacks and Hispanics among people aged fifty years and older. Our study showed disproportionate mortality among blacks with hip/pelvic fractures and emphasizes the importance of identifying contributors such as health-care quality (both Parkinson disease-related and general) and access to and utilization of specialty care.

The reduced mortality found among Hispanics in our data set, however, suggests that socioeconomic factors may not be the only consideration when assessing differences related to race/ethnicity. Our findings are consistent with previous studies that have shown similar differences related to race/ethnicity in all-cause mortality[32]. Compared with whites, blacks demonstrate higher and Hispanics demonstrate lower all-cause mortality[32]. Socioeconomic differences have been implicated in the higher all-cause mortality among blacks[32]; however, socioeconomic differences may not explain the lower mortality in Hispanics. Hispanics in the U.S. demonstrate lower all-cause mortality compared with non-Hispanics despite lower socioeconomic status and lower rate of health insurance coverage[33,34]. Three theories to explain this paradox include (1) migration patterns that involve healthier people emigrating to the U.S. and less healthy people returning to their native country; (2) positive cultural differences, such as diet or family structure; and (3) potential data artifacts. Investigators have also found that this may be a feature specific to certain Hispanic subgroups related to national origin or ancestry[34,35]. We cannot address migration patterns or cultural differences on the basis of the administrative data used in our study.

We found increased mortality associated with Parkinson disease similar to that associated with other conditions, such as dementia, kidney disease, chronic obstructive pulmonary disease, and diabetes. Previous reports specific to Parkinson disease and hip fracture have revealed conflicting findings. Studies published in 1980 and 1990 showed increased mortality following hip fracture in patients with Parkinson disease[36,37]. These early studies, however, included patients without access to therapies such as deep brain stimulation or aggressive rehabilitation protocols that are in current use. Three recently published studies demonstrated no relationship between Parkinson disease and mortality after hip fracture[25,29,38]. However, all were based on relatively small samples, the largest being 2692 subjects[29]. In contrast, our study includes data from 1,980,401

Medicare beneficiaries diagnosed with hip/pelvic fracture, representing the entire elderly hip/pelvic fracture population in the U.S.

Our findings suggest that treatment strategies to prevent hip/pelvic fracture and reduce mortality after fracture, particularly in men with Parkinson disease, have the potential to have a substantial public health impact. Most studies have investigated the prevention and treatment of hip fractures in women because of their higher risk for sustaining a hip fracture. Even though women are more likely to sustain a fracture, men are more likely to die after the fracture. Therefore preventative screenings and treatment strategies targeting those at risk for falls and subsequent hip fracture should not be limited to women[25] as they could be potentially life-saving for men. One example is screening for osteoporosis, a risk factor for hip fracture. A statement recently published by the U.S. Preventive Services Task Force provided specific recommendations for osteoporosis screening for women but did not provide a recommendation for men because of insufficient evidence. Given the lack of evidence to support osteoporosis screening for men, it is likely that osteoporosis is underdiagnosed in men. This may be particularly true for men with Parkinson disease, who are more likely to have low bone mineral density compared with healthy controls[9,39]. In their study of 177 patients newly diagnosed with Parkinson disease, Eng et al.[40] reported that only 11% of men had been previously screened for low bone mineral density compared with 71% of women. Evaluation provided by a physical therapist may also assist in preventing hip/pelvic fracture by identifying, through gait and balance analysis, patients with Parkinson disease who are at risk for falls[41,42] and by providing treatment to improve gait and postural instability, thus reducing the risk of falls[43-45].

Coordinated care during the perioperative phase may also help to reduce postfracture mortality of patients with Parkinson disease. Hip/pelvic fracture and the subsequent hospitalization can interrupt complex Parkinson disease medication regimens, reduce efficacy of Parkinson disease medications, and result in a decline in functional mobility[46-49]. Recent reports highlight the clinical problems faced by patients with Parkinson disease when hospitalized, such as frequent medication errors, infections, confusion, falls, and decubitus ulcers[46-49]. An interdisciplinary team that is educated in the complexities of Parkinson disease management likely improves outcomes[49]. A small retrospective study of patients with Parkinson disease who underwent a total knee arthroplasty showed that early involvement of a neurologist in the postoperative phase resulted in significantly shorter hospital stays and improved early outcomes[50], suggesting the need for early neurologic consultation to reduce associated morbidities.

Our study had limitations. There are a number of factors proposed to be related to mortality after hip/pelvic fracture for which we could not account, including prefracture residence[27], previous level of function[27], smoking[25], fracture type[30,51], and type of postfracture management. These variables are not contained in the Medicare database[52]. There was also no way to track Parkinson disease or comorbidity severity, which likely remain important uncontrolled confounders. We were not able to validate the accuracy of the diagnosis of Parkinson disease, so conditions mimicking Parkinson disease such as multiple system atrophy may have been misdiagnosed as Parkinson disease and could have influenced the results. However, atypical parkinsonism represent only a small percentage of the total cases presenting with parkinsonism[53,54]. Minority representation in our data set is lower than that of the U.S. population[55]. The difference in minority representation in our data set, however, is likely influenced by selection of only Medicare beneficiaries who had sustained a hip/pelvic fracture. Whites are more likely to sustain a hip/pelvic fracture than minority populations[56,57], which may explain the discrepancy. The hip fracture variable provided in the Medicare Beneficiary Annual Summary File includes all hip and pelvic fractures that the Centers for Medicare & Medicaid Services (CMS) determined to be relevant to classify as hip fractures. We were unable to identify fracture subtypes, postfracture management, operative procedure, or nonoperative approach provided for each patient. The goal of our current study, however, was to assess the mortality associated with any hip/pelvic fracture in patients with Parkinson disease, a population prone to immobility due to the neurodegenerative disease. Moreover, the inclusion of pelvic fractures, which have lower associated mortality[58,59], likely resulted in an underestimate of the true mortality associated with femoral and intertrochanteric fractures in patients with Parkinson disease. Postural instability in Parkinson disease is associated with an increased risk of falls, and, although the distribution of anatomical site cannot be determined from these data, high-energy fractures may be more likely in people with Parkinson disease. The increased mortality that we observed may reflect a greater percentage of high-energy fractures or a greater tendency toward high-energy fractures.

Despite these limitations, our study provides valuable information on the relative mortality of people with Parkinson disease and hip/pelvic fracture. The risk of death after hip/pelvic fracture in people with Parkinson disease varies according to demographic factors. Mortality is increased substantially after hip/pelvic fracture among patients with Parkinson disease. Future studies to understand the factors that contribute to increased mortality after hip/pelvic fracture in patients with Parkinson disease and in subpopulations will help guide treatment strategies to reduce morbidity and mortality in these complex cases.

Appendix

(eA) A table showing ICD-9 codes representing the hip fracture diagnosis in the Medicare Beneficiary Annual Summary File is available with the online version of this article as a data supplement at jbjs.org. ■

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