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Comorbid Parkinson's disease, falls and fractures in the 2010 National Emergency Department Sample

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Abstract

Introduction—Parkinson's disease (PD) is a progressive, neurodegenerative disorder of multifactorial etiology affecting ~1% of older adults. Research focused on linking PD to falls and bone fractures has been limited in Emergency Department (ED) settings, where most injuries are identified. We assessed whether injured U.S. ED admissions with PD diagnoses were more likely to exhibit comorbid fall- or non-fall related bone fractures and whether a PD diagnosis with a concomitant fall or bone fracture is linked to worse prognosis.

Methods—We performed secondary analyses of 2010 Healthcare Utilization Project National ED Sample from 4,253,987 admissions to U.S. EDs linked to injured elderly patients. ED discharges with ICD-9-CM code (332.0) were identified as PD and those with ICD-9-CM code (800.0–829.0) were used to define bone fracture location. Linear and logistic regression models were constructed to estimate slopes (B) and odds ratios (OR) with 95% confidence intervals (CI).

Results—PD admissions had 28% increased adjusted prevalence of bone fracture. Non-fall injuries showed stronger relationship between PD and bone fracture ($OR_{adj} = 1.33$, 95% CI: 1.22–1.45) than fall injuries ($OR_{adj} = 1.06$, 95% CI: 1.01–1.10). PD had the strongest impact on hospitalization length when bone fracture and fall co-occurred, and total charges were directly associated with PD only for fall injuries. Finally, PD status was not related to in-hospital death in this population.

Conclusions—Among injured U.S. ED elderly patient visits, those with PD had higher bone fracture prevalence and more resource utilization especially among fall-related injuries. No association of PD with in-hospital death was noted.

Keywords

Parkinson's disease; Injury; Emergency Department; Healthcare utilization

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Conflict of interest

None.

1. Introduction

Parkinson's disease (PD) is a progressive, neurodegenerative disorder of multifactorial etiology affecting ~1% of older adults. Recent studies have suggested that PD may be a risk factor for hypovitaminosis D [1], low bone mass density (BMD) [2–5] as well as osteoporosis [1,6–8], falls [9,10], and bone fractures [2,9–17]. The most commonly identified type of bone fracture in PD patients is a hip (or neck of femur) fracture [2,15,16,18,19] and the majority of bone fractures have been attributed to fall injuries [9,20]. It has been postulated that symptoms of PD can reduce mobility [1,20], leading to simultaneous reduction in sunlight exposure [9,12] and increase in bone resorption [18] subsequently resulting in increased likelihood of bone fractures. Whereas aging itself may be accompanied by worsening of bone health [12], PD-affected individuals may experience a higher risk of fall injuries and bone fractures because of the multitude of motor and non-motor symptoms and their associated treatments [5,9,12]. Furthermore, surgical intervention related to bone fractures in PD patients remains controversial [19], highlighting the importance of osteoporosis and injury prevention among PD patients.

To date, research focused on linking PD to healthcare utilization and outcomes related to falls and bone fractures has been limited, especially in emergency care settings, where most injuries are identified. In a cross-sectional study, we performed secondary analyses of the 2010 Healthcare Utilization Project (HCUP) National Emergency Department Sample (NEDS) data among injured elderly patients admitted to U.S. Emergency Departments (EDs) to assess whether admissions linked to injured ED patients diagnosed with PD are more likely than those not diagnosed with PD to have comorbid fall- and non-fall related bone fracture and whether PD diagnosis with concomitant fall or bone fracture is linked to worse prognosis based on length of hospital stay, cost of hospitalization and in-hospital death. Since falls may or may not mediate the relationship between PD and bone fractures, we hypothesized that admissions linked to elderly ED patients diagnosed with PD would be more likely to experience fall- and non-fall related bone fracture as compared to those not diagnosed with PD. Furthermore, we hypothesized that resource utilization related to falls and bone fractures would be exacerbated by a PD diagnosis, given the disabling aspect of PD.

2. materials & methods

2.1. Database

Sponsored by the Agency for Healthcare Research and Quality, the HCUP consists of publicly available databases and software tools created as a federal-state-industry partnership to support decision-making. NEDS is the largest all-payer ED database in the U.S., yielding national and regional estimates of hospital-based ED visits, with data on ~30 million discharges representing ~130 million ED visits each year. Since 2006, the NEDS samples were selected from the American Hospital Association community, non-rehabilitation hospitals participating in the State Inpatient Databases (patients initially seen in the ED and then admitted to the same hospital) and State Emergency Department Databases (ED treat-and-release visits or transfers to another hospital) and include

information on geographic, hospital and patient characteristics as well as the nature of the visits.

Between January 1 and December 31, 2010, NEDS data were compiled from 961 hospitals located in 28 participating States (AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MN, MO, NC, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, and WI), representing a 20% stratified sample of U.S. EDs. Stratification was based on five characteristics: geographic region (Northeast, Midwest, South and West), trauma center designation (trauma level I, II, III and non-trauma), hospital urban-rural location (large metropolitan, small metropolitan, micropolitan, and non-urban residual), teaching status (teaching, non-teaching) and ownership (public, for-profit and not-for-profit). The database includes clinical and resource information during ED visits, encompassing demographic information, admissions, injuries, diagnoses (up to 15), payment source, total hospital charges for inpatient stays of ED visits that result in admission, procedures categorized according to the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) and the Current Procedural Terminology, as well as death in ED, if present. In this study, ED admissions for patients 65 years and older, with an injury-related diagnosis, were selected from the 2010 NEDS. We excluded all ED admissions corresponding to ED patients <65 years of age and those with missing data on age ($n = 18,236,875$) as well as non-injured patients and those with missing data on injury status ($n = 3,930,483$).

2.2. Variable definitions

ED discharges with an ICD-9-CM code of 332.0 were identified as corresponding to patients with a PD diagnosis. Moreover, ED discharges with a diagnostic ICD-9-CM code ranging from 800.0 to 829.0 were used to define presence or absence of an adverse outcome, namely bone fracture of the “skull”, “spine & trunk”, “lower limb” or “upper limb”. Covariates were classified into three categories, namely, injury-, hospital- and patient-related characteristics. Injury-related variables were used to characterize discharges in terms of *injury status* (principal admitting diagnosis, not principal admitting diagnosis), *injury intent* (intentional, unintentional) and *injury by falling* (no, yes). Stratified analyses were performed according to presence or absence of bone fracture of the “skull”, “spine & trunk”, “lower limb” or “upper limb” as well as whether or not injury was related to falling as determined by *injury by falling* (no, yes). Hospitals were characterized by U.S. census region (Northeast, Midwest, South, West), urban-rural location (Urban, Rural), trauma center designation (Non-trauma center, Trauma level I, Trauma level II, Trauma level III, Unknown), teaching status (Non-teaching, Teaching) and ownership/control (Public, Private – Non-Profit, Private – Invest-Own, Unknown). Patient characteristics included sex (Male, Female), age (‘65–69’, ‘70–74’, ‘75–79’, ‘80+’ years), household socioeconomic status (in quartiles) as denoted by the patient's zip-code (‘\$1–\$40,999’, ‘\$41,000–\$50,999’, ‘\$51,000–\$66,999’, ‘\$67,000 or more’) and the 17-item Charlson's comorbidity index using ICD-9-CM diagnostic codes, categorized as ‘0’, ‘1’ and ‘2+’. Selected healthcare utilization outcomes were defined based on the following variables: length of hospitalization (in days), total charges (in U.S. dollars (\$)) in the ED and in the hospital among patients that were hospitalized and death in the ED and in the hospital among patients that were hospitalized.

2.3. Statistical analysis

All statistical analyses were conducted using STATA version 14 (STATA Corp, College Station, TX), taking into account the complex sampling design using stratum (NEDS_STRATUM) and discharge weight (discwt) variables and STATA's *svy* commands. First, we estimated the prevalence of PD diagnosis and bone fractures according to demographic, socioeconomic and clinical characteristics. Second, we assessed the relationship between PD (exposure variable) and bone fractures (outcome variables), before and after adjustment for potential confounders, overall, and according to presence or absence of fall as an external cause of injury (stratifying variable). Finally, we examined PD as a predictor of length of hospital stay, cost of hospitalization and in-hospital death, overall, and according to presence of bone fractures or falling as an external cause of injury (stratifying variables). Summary statistics, including weighted means, proportions and totals, were calculated taking sampling design complexity into account. Bivariate analyses were performed using design-based F-tests. Multivariable analyses included linear and logistic regression modeling to estimate unstandardized regression (B) coefficients and odds ratios (OR) with their 95% confidence intervals (CI), respectively. Of note, B coefficients can be interpreted as the average increase in length of hospital stay or cost of hospitalization associated with PD. Adjustment was performed for hospital and patient characteristics in the context of bone fracture as the outcome of interest and for injury-, hospital- and patient characteristics when the outcomes were defined as length of hospital stay, cost of hospitalization and in-hospital death. Two-sided statistical tests were conducted at an alpha level of 0.05.

3. Results

Table 1 shows the distribution of the study sample characteristics and the prevalence of PD and bone fractures across levels of those characteristics. Of 4,253,987 ED admissions for elderly patients treated for injuries across the United States in 2010, the vast majority (83.6%) had injury as their principle admitting diagnosis, with 91.3% being unintentional in nature and over half (58.4%) resulting from falls. Also, most of these injuries were reported in urban areas (78.7%), at trauma level III centers (67.2%) or at non-teaching hospitals (66.8%). Furthermore, 63.4% of these injuries corresponded to female patients, with 45.6% above the age of 80 years.

Overall, PD prevalence was 1.61% (95% CI: 1.55%–1.68%) and was significantly higher in admissions with injury as non-principal diagnosis (2.11%) vs. admissions with injury as principal diagnosis (1.51%). Importantly, fall-related injuries were associated with a higher prevalence of PD (2.07%) as compared to injuries not related to falls (0.97%). PD prevalence was significantly higher in urban vs. rural (1.72% vs. 1.22%) areas and was highest at trauma level I centers (2.00%), teaching hospitals (1.76%) as well as “private – invest-own” hospitals (1.63%), with variations according to U.S. Census regions of borderline significance. As expected, PD was more prevalent in men vs. women (2.18% vs. 1.29%), and the age group of 75–79 years experienced the highest PD prevalence (2.09%). Comorbidity and higher socio-economic status were associated with higher PD prevalence.

Bone fractures were highly prevalent in this population (29.41% overall), with a higher prevalence in patients primarily admitted to the ED after an injury (31.41% vs. 19.24%) and for unintentional vs. intentional (29.85% vs. 24.81%) injuries. Moreover, bone fractures were more prevalent among fall injuries (38.34%), in the West coast, in non-trauma centers, in teaching or private hospitals, among women, in the very old (80+ years) as well as higher income categories and at higher levels of comorbidity.

Table 2 presents logistic regression models examining the relationship between PD and bone fracture outcomes (overall and site-specific) in injured elderly ED admissions, according to fall status. Overall, PD was associated with a 28% increased prevalence of bone fracture irrespective of fall status, an association that remained unaltered after adjustment for hospital- and patient-related characteristics. This association was the strongest in the case of lower limb injuries ($OR_{adj} = 1.34$, 95% CI: 1.27–1.42). Other sites of injuries for which prevalent bone fracture was linked to PD included the skull, spine and trunk. A stronger relationship was observed between PD and bone fractures when injuries were not attributed to a fall ($OR_{adj} = 1.33$, 95% CI: 1.22–1.45) than when injuries were attributed to a fall ($OR_{adj} = 1.06$, 95% CI: 1.01–1.10).

Table 3 shows the relationship of PD with length of hospitalization and total hospital charges according to bone fracture and fall status. After adjusting for injury, hospital and patient-related characteristics, the association between PD and length of hospitalization was the strongest in the context of admissions with concomitant falls and bone fractures (unstandardized regression coefficient (B) = +0.62, 95% CI: +0.49; +0.75). A fall with no bone fracture was a condition in which PD had the lowest effect on length of hospitalization (B = +0.22, 95% CI: +0.15; +0.29). Similarly, in multivariable models, total charges were associated with PD only in the context of a fall injury irrespective of whether (B = +\$3565.4, 95% CI: +\$2411.0; +\$4719.9) or not (B = +\$758.9, 95% CI: +\$255.6; +\$1262.2) bone fracture occurred. In contrast, PD status was not linked to in-hospital death in the fully adjusted models and within any of the bone fracture/fall status strata (Table 4).

4. Discussion

In a cross-sectional study, we performed secondary analyses of the 2010 HCUP NEDS data among U.S. ED admissions for injured elderly patients to assess if PD diagnosis was linked to fall- and non-fall related bone fractures and to worse prognosis based on length of hospital stay, cost of hospitalization and in-hospital death in this patient population. The prevalence rates of PD and bone fracture were estimated at 1.61% and 29.41%, respectively. PD was associated with a 28% increased prevalence of bone fracture, after adjustment for hospital- and patient-related characteristics. Furthermore, PD was more strongly associated with non-fall than fall-related bone fractures. PD had the strongest relationship with length of hospitalization if bone fractures and falls co-occurred; similarly, total charges were associated with PD only in the context of a fall injury, whereas in-hospital death was not related to PD in this population.

Previous research highlighted the burden of fall-related injuries in PD patients, which have been attributed to intrinsic rather than extrinsic factors [17]. PD patients – especially women

– may experience greater difficulties with their activities of daily living and higher risks of fall-related injuries as a result of postural instability and hypotension, unsteady gait, bradykinesia and rigidity; in addition, age, PD duration, difficulties in activities of daily living, severity of motor symptoms including abnormal posture, freezing of gait, frontal impairment, impaired balance and reduced knee extensor strength as well as use of dopaminergic drugs (e.g. levodopa) have been reported as potentially important risk factors for falling among PD patients [2,9,14,16].

Our study results suggest that the link between PD and bone fracture may be stronger in the context of patients who did not experience a fall as compared to those who did experience a fall. Although it may appear counterintuitive, this finding suggests that osteoporosis may play an important role in linking PD to bone fracture, irrespective of fall injury. Evidence from cross-sectional, case-control and cohort studies suggests that individuals diagnosed with PD are at increased risk for osteoporosis [3]. The elevated risk of bone fracture in PD patients has been attributed to osteoporosis to which female sex, old age, PD duration and severity, low body mass index, reduced mobility, endocrine, nutritional and iatrogenic factors may contribute [9]. A plausible explanation is that osteoporosis mediates the relationship between PD and bone fracture predominantly among individuals who did not experience a fall [1,3,5–8,12,15–17]. Alternatively, higher rates of comorbidities (e.g. syncope) among PD-affected patients could lead to loss of postural tone and subsequent injuries that may not be coded as a mechanical fall.

Our results are consistent with previous studies that identified hip fractures as the most frequently reported injuries in PD patients. In fact, fall-related injuries – especially those resulting in hip fractures – are the most common causes of hospitalization in PD patients and the most disabling features of PD affecting 70–87% of patients who survive for 20 years after PD onset [6,9,14]. Nearly half of bone fractures are hip fractures which are more common among women than men, frequently associated with fall-related injuries and have been linked to worse health outcomes, including death, disability and medical costs than other types of fractures [6,16]. The larger proportion of hip fracture vs. other fractures in PD-affected individuals has been attributed to neuromuscular deficits leading to worsening of osteoporosis in the hip area, a tendency to fall backwards or to the side and inadequately directed arm movements among those who experience a fall [2].

Furthermore, the magnitude of the association between PD and bone fracture (28% increased odds) is in line with previous research. In a retrospective cohort study of 200 PD patients and 200 age- and sex-matched controls, fractures were significantly more common in the PD cases than controls (PD 15%, controls 7.5%; $p=0.007$), and the commonest site of fracture was the femur in case group (11 of 38 fractures) and the forearm in the control group (5 of 16 fractures) [11]. In a prospective cohort study of 8105 older women with known PD status at four clinical centers of the Study of Osteoporotic Fractures, women with PD had a 2.6-fold higher age-adjusted risk for incident hip fracture; furthermore, PD was not significantly associated with non-spine, non-hip fractures [4]. Finally, a case-control study was conducted to examine bone fracture risk associated with parkinsonism (including PD) and drugs used to treat these conditions, whereby cases were subjects with any fracture during the year 2000 ($n = 124,655$) and three controls were matched by age and sex to each

case ($n = 373,962$); parkinsonism was associated with bone fracture risk ($OR_{adj} = 1.2$; 95% CI: 1.0–1.4), with the risk being higher especially in males younger than 75 years [21].

In this study, we examined whether PD was linked to fractures of the skull, spine, trunk, lower limb or upper limb among injured elderly patients admitted to U.S. EDs. PD was found to be more strongly associated with fall- and non-fall related bone fractures of the spine, trunk and lower limbs. This finding is consistent with previous studies that identified PD as a specific risk factor for hip (or femoral neck) fracture [14–16].

Our results should be interpreted with caution and in light of several limitations. First, little data could be gleaned from HCUP NEDS regarding diagnostic tools used to distinguish PD and non-PD patients, including PD-specific medications. Second, each patient may contribute multiple records to HCUP NEDS, affecting the estimated prevalence of PD and related conditions. Third, the cross-sectional design precludes examination of temporal or causal relationships between PD, falls, bone fractures and their related outcomes. Fourth, the quality and completeness of HCUP NEDS data depends on existing medical records, which may result in differential misclassification and residual confounding biases. Whereas the validity and reliability of fall data has not been previously examined in the HCUP NEDS [22], differential misclassification of falls is likely due to multiple competing diagnoses including PD, falls and fractures. Also, the hypothesized relationship between PD and various outcomes may be confounded by patient and hospital characteristics that were not specifically assessed in the HCUP NEDS, including disease duration, sleep disorders, psychotropic drugs, smoking habits and vitamin D supplementation. Finally, study results can only be generalized to a selected group of injured elderly patients admitted to U.S. EDs. Nevertheless, administrative databases are ideal for providing a large sample with sufficient power to detect uncommon occurrences, including PD.

The health impact of a fall or bone fracture on ED patients with or without PD has rarely been evaluated. In this study, resource use determined by length of hospitalization and total charges (but not survival) was found to be associated with PD diagnosis, especially in the context of patients experiencing a fall-related injury. This finding is in line with the idea that PD is of itself a disabling condition and that individuals who experience a fall are expected to consume more resources if they had PD as a comorbid condition. Furthermore, the absence of a significant relationship of PD with in-hospital mortality risk or mortality risk among patients with bone fractures was inconsistent with recent studies by Low and colleagues based on the English Hospital Episodes Statistics database 2009–2013 [23] and by Harris-Hayes and colleagues in a retrospective cohort study of elderly Medicare beneficiaries diagnosed with hip/pelvic fracture from 2000 to 2005 [24]. Both studies concluded that PD was directly associated with mortality risk in hospitalized patients. These inconsistencies may be explained by methodological differences, including study design or population, between HCUP NEDS and other databases. Prospective cohort studies are needed to elucidate the temporal relationship between PD and osteoporosis-related outcomes. Also, comparative effectiveness and safety of various procedures related to bone fractures should be evaluated in the context of PD-affected individuals.

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Prevalence of Parkinson's disease and bone fractures with 95% confidence intervals according to injury, hospital and patient characteristics e National Emergency Department Surveillance System, 2010.

Table 1

	% of total admissions		Parkinson's disease		Bone fracture	
	Number of admissions	Prevalence	95% CI	Prevalence	95% CI	
Overall	4,253,987	1.61	1.55-1.68	29.41	(29.08–29.74)	
% of total admissions						
Injury characteristics:						
Injury status:			P < 0.0001		P < 0.0001	
Principal admitting dx	(83.6)	1.51	1.45–1.58	31.41	31.03–31.79	
Not principal admitting dx	(16.4)	2.11	2.01–2.21	19.24	18.84–19.65	
Injury intention:			P = 0.36		P < 0.0001	
Intentional	(8.7)	1.56	1.44–1.68	24.81	23.12–26.57	
Unintentional	(91.3)	1.62	1.55–1.68	29.85	29.49–30.20	
Fall injury:			P < 0.0001		P < 0.0001	
Yes	(58.4)	2.07	1.99–2.16	38.34	37.98–38.71	
No	(41.6)	0.97	0.91–1.01	16.86	16.21–17.53	
% of total admissions						
Hospital characteristics:						
U.S. census region			P = 0.055		P = 0.0014	
Northeast	(19.4)	1.51	1.37–1.66	28.48	27.70–29.28	
Midwest	(24.7)	1.72	1.60–1.85	29.99	29.27–30.72	
South	(37.6)	1.55	1.45–1.66	29.05	28.52–29.60	
West	(18.3)	1.70	1.55–1.86	30.33	29.63–31.05	
Urban-Rural location of hospital			P < 0.0001		P = 0.26	
Urban	(78.7)	1.72	1.65–1.79	29.49	29.12–29.85	
Rural	(21.3)	1.22	1.12–1.33	29.12	28.53–29.72	
Trauma center designation			P = 0.0013		P < 0.0001	
Non-trauma center	(6.3)	1.73	1.53–1.95	36.39	34.68–38.13	
Trauma level I	(9.6)	2.00	1.72–2.32	31.57	30.59–32.57	
Trauma level II	(8.5)	1.71	1.46–1.99	29.74	28.22–31.31	
Trauma level III	(67.2)	1.53	1.46–1.59	28.05	27.69–28.40	
Unknown	(8.4)	1.67	1.46–1.91	32.23	30.88–33.62	

	% of total admissions		Parkinson's disease		Bone fracture	
	Number of admissions	Prevalence	95% CI	Prevalence	95% CI	
Teaching status:						
Non-teaching	(66.8)	1.54	1.47–1.61	28.43	28.08–28.78	
Teaching	(33.2)	1.76	1.64–1.89	31.39	30.67–32.11	
Hospital ownership:						
Public	(6.3)	1.29	1.16–1.44	27.61	26.57–28.67	
Private e Non-Profit	(8.9)	1.33	1.22–1.46	28.05	27.22–28.88	
Private e Invest-Own	(15.9)	1.63	1.51–1.77	28.63	27.91–29.36	
Unknown	(68.9)	1.67	1.59–1.76	29.93	29.49–30.37	
Patient characteristics:						
% of total admissions						
Sex:						
Male	(36.6)	2.18	2.09–2.28	23.39	23.04–23.75	
Female	(63.4)	1.29	1.23–1.34	32.88	32.52–33.24	
Age (years):						
65–69	(19.9)	0.81	0.75–0.87	23.79	23.43–24.16	
70–74	(17.0)	1.36	1.28–1.44	26.03	25.66–26.41	
75–79	(17.0)	2.09	1.97–2.20	28.96	28.56–29.37	
80+	(45.6)	1.87	1.79–1.96	33.26	32.88–33.63	
Household socioeconomic status (\$):						
\$1–\$40,999	(24.6)	1.29	1.21–1.38	28.04	27.49–28.58	
\$41,000–\$50,999	(27.3)	1.54	1.47–1.63	29.66	29.18–30.13	
\$51,000–\$66,999	(24.3)	1.67	1.59–1.77	29.83	29.34–30.33	
\$67,000+	(23.8)	1.99	1.87–2.11	30.16	29.64–30.68	
Charlson comorbidity index						
0	(36.9)	1.44	1.38–1.52	26.16	25.84–26.48	
1	(20.9)	1.91	1.83–2.00	32.55	31.99–33.12	
2+	(15.2)	1.90	1.80–2.00	38.75	38.13–39.37	

Dx = diagnosis; Note: P values are based on design-based F tests.

Table 2

Relationship of Parkinson's disease with bone fracture, overall and according to fall status – National Emergency Department Surveillance System, 2010.

	Unadjusted OR with PD (95% CI)	Adjusted ^a OR with PD (95% CI)
Bone fracture – Overall		
Any vs. None	1.28 (1.23; 1.33)	1.27 (1.22; 1.32)
Skull vs. No Skull	1.28 (1.16; 1.42)	1.20 (1.09; 1.33)
Spine & Trunk vs. No Spine & Trunk	1.35 (1.28; 1.42)	1.25 (1.18; 1.32)
Upper Limb vs. No Upper Limb	0.85 (0.79; 0.91)	0.92 (0.85; 0.98)
Lower Limb vs. No Lower Limb	1.36 (1.29; 1.43)	1.34 (1.27; 1.42)
Bone fracture – Fall		
Any vs. None	1.01 (0.96; 1.05)	1.06 (1.01; 1.10)
Skull vs. No Skull	1.09 (0.98; 1.21)	1.04 (0.93; 1.15)
Spine & Trunk vs. No Spine & Trunk	1.19 (1.12; 1.27)	1.16 (1.08; 1.23)
Upper Limb vs. No Upper Limb	0.68 (0.63; 0.74)	0.76 (0.70; 0.82)
Lower Limb vs. No Lower Limb	1.14 (1.08; 1.21)	1.19 (1.13; 1.26)
Bone fracture – Non-fall		
Any vs. None	1.47 (1.35; 1.61)	1.33 (1.22; 1.45)
Skull vs. No Skull	1.25 (0.88; 1.78)	1.09 (0.75; 1.58)
Spine & Trunk vs. No Spine & Trunk	1.53 (1.36; 1.72)	1.27 (1.12; 1.43)
Upper Limb vs. No Upper Limb	1.11 (0.94; 1.31)	1.12 (0.96; 1.31)
Lower Limb vs. No Lower Limb	1.36 (1.19; 1.56)	1.29 (1.13; 1.48)

^a Adjusted for hospital characteristics [U.S. census region (Northeast, Midwest, South, West), urban-rural location (Urban, Rural), trauma center designation (Non-trauma center, Trauma level I, Trauma level II, Trauma level III, Unknown), teaching status (Non-teaching, Teaching) and ownership/control (Public, Private – Non-Profit, Private – Invest-Own, Unknown)] and patients characteristics [sex (Male, Female), age ('65–69', '70–74', '75–79', '80+' years), household socioeconomic status ('\$1–\$40,999', '\$41,000–\$50,999', '\$51,000–\$66,999', '\$67,000 or more') and 17-item Charlson's comorbidity index ('0', '1' and '2+').

OR = Odds Ratio; PD = Parkinson's Disease; CI = Confidence Interval.

Table 3

Relationship of Parkinson's disease with length of hospitalization (in days) and total charges (in dollars) according to bone fracture and fall status – National Emergency Department Surveillance System, 2010.

	Fall		Non-fall	
	Unadjusted	Adjusted ^a	Unadjusted	Adjusted ^a
PD - not PD mean differences in length of hospitalization (days) B (95% CI)				
Bone fracture – Yes	0.86 (0.72; 1.00)	0.62 (0.49; 0.75)	0.91 (0.57; 1.25)	0.37 (0.02; 0.71)
Bone fracture – No	0.38 (0.30; 0.47)	0.22 (0.15; 0.29)	1.31 (1.09; 1.52)	0.36 (0.19; 0.53)
PD - not PD mean differences in total charges (\$) B (95% CI)				
Bone fracture – Yes	+6132.8 (+4730.2; +7535.3)	+3565.4 (+2411.0; +4719.9)	+3067.3 (–523.7; +6658.3)	–969.2 (–4341.5; +2403.0)
Bone fracture – No	+2313.8 (+1701.6; +2926.0)	+758.9 (+255.6; +1262.2)	+8060.6 (+6481.7; +9639.5)	+741.3 (–552.7; +2035.3)

^a Adjusted for injury characteristics [*injury status* (principal admitting diagnosis, not principal admitting diagnosis), *injury intent* (intentional, unintentional) and *injury by falling* (no, yes)], hospital characteristics [U.S. census region (Northeast, Midwest, South, West), urban-rural location (Urban, Rural), trauma center designation (Non-trauma center, Trauma level I, Trauma level II, Trauma level III, Unknown), teaching status (Non-teaching, Teaching) and ownership/control (Public, Private – Non-Profit, Private – Invest-Own, Unknown)] and patients characteristics [sex (Male, Female), age ('65–69', '70–74', '75–79', '80+' years), household socioeconomic status ('\$1–\$40,999', '\$41,000–\$50,999', '\$51,000–\$66,999', '\$67,000 or more') and 17-item Charlson's comorbidity index ('0', '1' and '2+')].

B = Unadjusted coefficient for standard linear regression; CI = Confidence Interval.

Table 4

Relationship of Parkinson's disease with in-hospital mortality risk according to bone fracture and fall status – National Emergency Department Surveillance System, 2010.

	Fall OR (95% CI)		Non-fall OR (95% CI)	
	Unadjusted	Adjusted^a	Unadjusted	Adjusted^a
Bone fracture – Yes	1.02 (0.74; 1.39)	0.85 (0.63; 1.16)	0.71 (0.39; 1.28)	0.55 (0.29; 1.03)
Bone fracture – No	1.09 (0.82; 1.45)	0.88 (0.65; 1.18)	1.71 (1.31; 2.23)	0.89 (0.67; 1.18)

^aAdjusted for injury characteristics [*injury status* (principal admitting diagnosis, not principal admitting diagnosis), *injury intent* (intentional, unintentional) and *injury by falling* (no, yes)], hospital characteristics [U.S. census region (Northeast, Midwest, South, West), urban-rural location (Urban, Rural), trauma center designation (Non-trauma center, Trauma level I, Trauma level II, Trauma level III, Unknown), teaching status (Non-teaching, Teaching) and ownership/control (Public, Private – Non-Profit, Private – Invest-Own, Unknown)] and patients characteristics [sex (Male, Female), age ('65–69', '70–74', '75–79', '80+' years), household socioeconomic status ('\$1–\$40,999', '\$41,000–\$50,999', '\$51,000–\$66,999', '\$67,000 or more') and 17-item Charlson's comorbidity index ('0', '1' and '2+').

OR = Odds Ratio; CI = Confidence Interval.