Published in final edited form as:

J Am Geriatr Soc. 2019 July ; 67(7): 1386–1392. doi:10.1111/jgs.15870.

Functional Outcomes After Hip Fracture in Independent Community-Dwelling Patients

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Abstract

OBJECTIVES: To determine predictors of new activities of daily living (ADLs) disability and worsened mobility disability and secondarily increased daily care hours received, in previously independent hip fracture patients.

DESIGN: Retrospective cohort study.

SETTING: Academic hospital with ambulatory follow-up.

PARTICIPANTS: Community-dwelling adults 65 years or older independent in ADLs undergoing hip fracture surgery in 2015 (n = 184).

MEASUREMENTS: Baseline, 3- and 6-month ADLs, mobility, and daily care hours received were ascertained by telephone survey and chart review. Comorbidities, medications, and characteristics of hospitalization were extracted from patient charts. Models for each outcome used logistic regression with a backward elimination strategy, adjusting a priori for age, sex, and race.

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Author Contributions: Jennifer A. Ouellet: overall study concept and design, data management, chart adjudications, interpretation of data, and preparation of the manuscript. Gregory M. Ouellet: overall study concept and design, data management and statistical analysis, interpretation of data, and preparation of manuscript. Alison M. Romegialli: overall study concept and design, data management, chart adjudications, interpretation of data, and preparation of manuscript. Marilyn Hirsch and Lisa Berardi: subject identification and data acquisition and manuscript preparation. Christine M. Ramsey: statistical analysis and interpretation of results. Leo M. Cooney Jr and Lisa Walke: overall study concept and design, results interpretation, and preparation of the manuscript.

Conflicts of Interest: The authors have no financial, personal, or potential conflicts of interest to disclose.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Sponsor's Role: None.

RESULTS: Predictors of new ADL disability at 3 months were dementia (odds ratio [OR] = 11.81; $P = .001$) and in-hospital delirium (OR = 4.20; $P = .002$), and at 6 months were age (OR = 1.04; $P = .014$), dementia (OR = 9.91; $P = .001$), in-hospital delirium (OR = 3.00; $P = .031$) and preadmission opiates (OR = 7.72; $P = .003$). Predictors of worsened mobility at 3 months were in-hospital delirium (OR = 4.48; $P = .001$) and number of medications (OR = 1.13; $P = .003$), and at 6 months were age (OR = 1.06; $P = .001$), preadmission opiates (OR = 7.23; $P = .005$), in-hospital delirium (OR = 3.10; $P = .019$), and number of medications (OR = 1.13; $P = .013$). Predictors of increased daily care hours received at 3 and 6 months were age (3 months: OR = 1.07; $P = .014$; 6 months: OR = 1.06; $P = .017$) and number of medications (3 months: OR = 1.13; $P = .004$; 6 months: OR = 1.22; $P = .013$). The proportion of patients with ADL disability and care hours received did not change from 3 to 6 months, yet there were significant improvements in mobility.

CONCLUSION: Age, dementia, in-hospital delirium, number of medications, and preadmission opiate use were predictors of poor outcomes in independent older adults following hip fracture. Further investigation is needed to identify factors associated with improved mobility measures from 3 to 6 months to ultimately optimize recovery.

Keywords

functional outcomes; hip fracture; older adults; independent; care hour needs

Hip fractures in adults older than 65 years of age result in significant morbidity, mortality, and increased healthcare costs. The 1-year mortality estimates range from 18% to 33% of all patients with hip fractures, with even higher rates among those with dementia or living in a nursing home.¹⁻³ Up to 50% of community dwellers before a hip fracture experience postfracture functional decline,⁴⁻⁷ and the resultant disabilities in activities of daily living (ADLs) and mobility are often sustained for months to years.⁷ Postfracture functional decline has important implications for quality of life and healthcare costs,⁸ and it leads to institutionalization in up to 20% of patients.⁷

Prior studies in community-dwelling older adults who have sustained hip fracture have included functionally heterogeneous populations^{5,9-12} and have established that the strongest risk factor for postfracture functional decline is prefracture disability.^{5,9-12} However, 60% of hip fractures occur in persons without preexisting disability,^{13,14} emphasizing the need to understand what factors predict functional decline in this important subgroup. Other risk factors for functional decline are age,^{11,15} multimorbidity,⁹ cognitive impairment,^{9,12,16,17} and in-hospital delirium.¹⁷⁻¹⁹ Whether these factors remain predictive in persons without prior disability remains unknown, preventing accurate prognostication.

The development of ADL or mobility disability can lead to increased care received, worsened quality of life, and increased healthcare costs. This has important consequences for patients, families, and the healthcare system, impacting quality of life and health of caregivers,²⁰⁻²² and causing financial burden.²³ Despite this, the number of daily hours of care received after hip fracture has been understudied.

Over the last several decades, identification of factors predictive of poor outcomes and optimization through geriatric comanagement has resulted in a decline in mortality and

readmission rates.^{24,25} This study contributes to the literature and clinical care of community-dwelling older adults by demonstrating factors predictive of poor outcomes in this population, allowing for potential modification or counseling for patients and caregivers. The goal of this study was to determine which factors predict new ADL disability, worsened mobility, and increased care hours received after hip fracture in patients who were previously independent in performing their ADLs.

METHODS

Study Sample

The National Surgical Quality Improvement Program (NSQIP) is a nationally validated risk-adjusted outcomes based program to measure and improve the quality of surgical care. Through NSQIP at Yale New Haven Health System, data were collected on all patients 65 years and older undergoing surgical repair for hip fracture from January 1, 2015, through December 31, 2015. Exclusion criteria included nursing home residence, presurgical dependence for any ADL, and fractures due to malignancy. Because these data were acquired in conjunction with NSQIP, nonoperative patients were not enrolled in the sample.

Data Collection

Two geriatricians performed chart reviews of the electronic medical record EPIC to obtain information from the hospitalization. Basic demographic information including age, sex, marital status, race, and living arrangement were collected. In addition, physical therapy, case management, and nursing assessments were analyzed for baseline ADL function and mobility before the admission. Electronic medical record problem list and physician notes were analyzed for the presence of medical comorbidities, laboratory results, in-hospital complications, and medications at admission and discharge.

Two NSQIP nurse research assistants obtained follow-up data at 3 and 6 months postsurgery through telephone interviews with the patient, if cognitively able and physically present at the time of the phone call, or his or her caregiver. A standardized questionnaire was used to ascertain living setting, hospital readmissions, mobility, ADLs, and number of care hours received.

This study was approved by the institutional review board at Yale University School of Medicine.

Outcomes

The primary outcomes of this study are the development of new ADL disability and new or worsened mobility disability. The secondary outcome is the development of increased daily care hours received.

New ADL Disability—Patients/caregivers were asked to report whether the patient was “independent,” “needs help,” or was “unable to do” each of the following ADLs: feeding, toileting, bathing, and dressing. New ADL disability was defined by any reported “needs

help” or “unable to do” at follow-up. Use of durable medical equipment (DME) to complete ADLs was considered “needs help.”

Worsened Mobility Disability—Patients/caregivers were asked to report whether the patient was “independent,” “needs help,” or was “unable to do” each of the following mobility items: simple ambulation, two-block ambulation, stair climb, and transfer from a bed or chair. A response of “needs help” or “unable to do” was classified as dependent. Use of DME to complete mobility tasks was considered “needs help.” The outcome of worsened mobility was achieved if the count of the total number of patient’s mobility dependencies at follow-up was greater than the count at baseline.

Increased Daily Care Hours Received—Patients/caregivers were asked to report hours of skilled and unskilled care per day (provided by professional caregivers or family) as “0,” “1 to 4,” “5 to 8,” “9 to 12,” or “more than 12.” The outcome of increased care hours received was achieved if any category higher than baseline was reported at follow-up.

Independent Variables

Comorbidities—The presence of several comorbidities shown to be associated with poor outcomes in patients with hip fracture were adjudicated from electronic patient charts: dementia,^{1,3,9,12,16,17} congestive heart failure (CHF),^{26,27} chronic kidney disease (CKD),^{28–30} and depression.³¹ Each condition was recognized as present if cited in the patient’s problem lists or physician notes. CHF was also considered present if there was reduced ejection fraction on available echocardiograms. Depression and dementia were also considered present if there was continuation of relevant medications during hospital admission: antidepressants for depression and cholinesterase inhibitors or memantine for dementia.

Medications—Potentially high-risk medications at hospital discharge were adjudicated from the electronic medical record including opiates, tramadol, antipsychotics, and benzodiazepines. Use of opiate and tramadol was measured at admission and discharge given significant changes in prescribing over the course of the index admission. Benzodiazepine and/or antipsychotic use was identified based on discharge only because admission and discharge prescription were highly correlated, with less than 5% of patients newly starting these medications.

Hospitalization—Data on admission laboratory values, fracture type and laterality, length of stay, and hospital complications were abstracted from patient charts. Surgical procedures including open reduction and internal fixation (ORIF), hip hemiarthroplasty, and total hip arthroplasty were identified by *International Classification of Diseases, Tenth Revision* (ICD-10) diagnosis codes. Laboratory results collected included hemoglobin as a marker of acute blood loss anemia and creatinine as a marker of acute kidney injury, both associated with worse outcomes after hip fracture.^{32,33} Hospital complications included intensive care unit (ICU) admission and presence of in-hospital delirium. Presence of in-hospital delirium was ascertained through use of a validated chart review tool³⁴ and through extensive review of physician and nursing notes for elements of the Confusion Assessment Method including

(1) acute change in and fluctuations in mental status, and (2) inattention and either (3) disorganized thinking or (4) altered level of consciousness.^{34–36} Interrater reliability was 89%.

Death—Deaths were ascertained through follow-up interviews, chart, and local obituary review.

Analysis

Baseline characteristics of survivors were compared with decedents at 3- and 6-month follow-up using the χ^2 test for categorical variables and *t* test for continuous variables. The proportions of patients with dependence in each ADL and mobility item were compared between baseline and 3 months and between baseline and 6 months using paired *t* tests.

To test the unadjusted associations between prespecified independent variables and the outcomes, development of a new ADL disability, worsened mobility, and increased care hours received, we used logistic regression. In building multivariable models, age, sex, and race were included a priori. Other variables detailed in the methods previously described were selected for inclusion in the multivariable models using a backward elimination strategy with a threshold $P < .10$.

Sensitivity Analysis

Due to potential attrition bias from dropouts and deaths, we conducted a sensitivity analysis to understand how robust our models were to even extreme assumptions about patients who were not eligible to experience each outcome, either due to death or loss to follow-up. The extreme assumption was that if the participants had not died or been lost that they would have no new ADL disability, no worsening in mobility, and no increase in care hours received. The multivariable models were then created with these assumptions, and resultant measures of association (OR for logistic regression and relative risk ratio for multinomial logistic regression) were then compared with the original models.

RESULTS

During the study period, a total of 368 patients had surgical treatment of hip fractures at Yale New Haven Hospital. The analytic sample includes the 184 patients who were community dwelling, completely independent in ADLs before hip fracture, and not lost to follow-up at 3 months.

By 3 months after hip fracture, 21 patients had died (11.4%), and 2 were lost to follow-up or had incomplete data. By 6 months, an additional 5 patients (14.1%) had died, and 9 were lost to follow-up or had incomplete data. Complete follow-up data for all outcomes (ADL function, mobility, and daily care hours received) were available for 161 patients at 3 months and 147 patients at 6 months.

Baseline characteristics for survivors and decedents at 6 months can be found in Table 1. Baseline characteristics for survivors and decedents at 3 and 6 months can be found in Table S1. Mean age was 83.7 years, and most of the sample was female (67.9%) and white (94%).

Femoral neck fractures occurred in 54.4%, and most patients underwent an ORIF (64.1%) as the surgical intervention. Of the comorbidities investigated, 10.9% had dementia, 18.5% had depression, 19.0% had CKD, and 21.2% had CHF. The mean number of medications at admission was 7.9 (+ 4.56). The mean admission hemoglobin was 12.3; creatinine was 1.1. Many patients (23.9%) experienced delirium during hospitalization. Of the high-risk medications investigated at admission, 17.4% of patients were prescribed benzodiazepines, 10.3% were prescribed opiates, 2.7% were prescribed antipsychotics, and 9.8% were prescribed tramadol. Most patients (59.2%) were discharged on opiates. The decedents at 6 months were more likely to be older, have longer hospital length of stay, have ICU admission during hospitalization, lower admission hemoglobin, and to be discharged on opiates ($P < .05$ for all).

Development of New ADL Disability

The total number of ADL disabilities and the proportion of patients with each ADL disability are presented in Table 2. At baseline, all patients reported independence with all ADLs. At 3 months, 115 (71.4%) patients reported no ADL disability, and 46 (28.6%) patients reported one or more ADL disability. At 6 months, 113 (76.9%) patients reported no ADL disability; 34 (23.1%) patients reported one or more ADL disability. There were no statistical differences between the proportions of patients with each ADL disability between 3 and 6 months.

In a multivariable analysis, factors significantly associated with development of new ADL disability at 3 months include dementia (OR = 11.81; $P = .001$), in-hospital delirium (OR = 4.20; $P = .002$), and lower admission hemoglobin (OR = 1.39 for each g/dl decline; $P = .014$). At 6 months, factors associated with the development of new ADL disability include age (OR = 1.09; $P = .014$), dementia (OR = 9.91; $P = .001$), in-hospital delirium (OR = 3.00; $P = .031$), and opiate prescription at admission (OR = 7.72; $P = .003$) (Table 3).

Mobility Disability

The total number of mobility disabilities and the proportion of patients with each mobility disability are presented in Table 2. At baseline, 160 (87.0%) patients reported independence in all mobility measures, and 24 (13.0%) patients reported one or more mobility disabilities. At 3 months, 78 (48.5%) patients reported no mobility disability, and 83 (51.5%) patients reported one or more mobility disabilities. At 6 months, 84 (57.1%) patients reported independence in all mobility measures, and 63 (42.9%) reported one or more mobility disabilities. Disability in walking two blocks or climbing stairs was significantly less frequent at 6-month follow-up compared with 3-month follow-up.

In a multivariable analysis, factors significantly associated with new mobility disability at 3 months include in-hospital delirium (OR = 4.58; $P = .001$) and number of medications (OR = 1.13; $P = .003$). Factors significantly associated with development of new mobility disability at 6 months include age (OR = 1.11; $P = .001$), in-hospital delirium (OR = 3.10; $P = .019$), number of medications (OR = 1.13; $P = .013$), and opiate prescription at admission (OR = 7.23; $P = .005$) (Table 4).

Development of Increased Daily Care Hours Received

Of the 150 patients with collected data for baseline care hours received, 125 (83.4%) had zero hours of care received, 19 (12.7%) had 1 to 4 hours of care received, 4 (2.7%) had 5 to 8 hours of care received, and 2 (1.3%) had 12 or more hours of care received. The percentage of patients receiving 1 to 8 (1–4 or 5–8) hours of care increased from 15.4% at baseline to 26.1% at 3 months and 27.7% at 6 months. Those receiving greater than 9 hours increased from 1.3% at baseline to 16.8% at 3 months and then decreased to 12.2% at 6 months (Table 2).

In a multivariable analysis, factors significantly associated with the development of increased care hours received included age (OR = 1.07; $P = .014$; OR = 1.06; $P = .017$) and number of medications (OR = 1.13; $P = .004$; OR = 1.22; $P = .013$) at 3 and 6 months, respectively, with a trend toward significance of in-hospital delirium (OR = 2.36; $P = .058$) at 3 months (Table 5).

Sensitivity Analysis

Most predictors were robust to the sensitivity analysis at 3 and 6 months. In the analysis of development of ADL disability, hemoglobin level at admission lost significance at 3-month follow-up. All other factors remained significant (Table 3). In the analysis of worsened mobility disability, all factors retained significance at 3 and 6 months (Table 4). For the outcome of increased care hours received, age lost significance at 3- and 6-month follow-up. All other factors remained significant (Table 5).

DISCUSSION

This study demonstrates that for functionally independent persons before hip fracture, cognitive impairment, including baseline dementia and in-hospital delirium, are major predictors of development of ADL and mobility disability. Other factors associated with the outcomes investigated included age, number of medications, low admission hemoglobin, and opiate prescription at admission. The predictive value of these factors may be as potential surrogates for overall comorbidity as a predictor of adverse outcomes. We also demonstrated that the proportion of patients with ADL disability at 3 months was unchanged at 6 months. In contrast, the proportion of patients with mobility disability was greater at 3 months than at 6 months, indicating recovery over time, specifically regarding climbing stairs and walking two blocks.

This work adds to the literature by showing worsened outcomes in functionally independent populations with cognitive impairment or in-hospital delirium, supporting the importance of accurate screening for these conditions at admission and throughout the hospitalization. In functionally heterogeneous populations, cognitive impairment and in-hospital delirium, in addition to preexisting disability, have consistently been shown to result in worse outcomes. By excluding patients with functional disability, we were able to show that dementia and in-hospital delirium remain important predictors of disability. Although novel, the finding of admission prescription of opiate medications leading to the development of ADL disability is not surprising. Patients taking opiates before admission were likely to have chronic

conditions predisposing them to disability. Although we hypothesized that other high-risk medications including benzodiazepines and antipsychotics may be associated with functional decline, we did not have enough power to identify significant changes.

The finding of improvement in mobility measures, specifically climbing stairs and walking two blocks, between 3- and 6-month follow-up is particularly important when considering that prior studies in functionally heterogeneous populations demonstrated no significant change in function.^{7,37} This finding highlights the need for additional investigation to the postoperative rehabilitation course, to ascertain those factors that may optimize the ability for recovery of mobility independence.

This study also adds novel information about predictors of increased care hours received after hip fracture. Increase in daily care hours received has important implications on quality of life for patients, caregivers, and cost to the healthcare system, and it can lead to the need for institutionalization. In addition, utilization of family members for caregiving needs was shown previously to have potentially negative impacts on the quality of life and health of caregivers,^{20–22} in addition to lost wages.²³ As such, the ability to predict factors associated with increased care hours received is important for patient and caregiver counseling.

This study has several strengths. First, this study focuses on a population that may have the most potential for long-term recovery after hip fracture, those who were previously independent. Second, we were able to assess impact of functional disabilities on care received. Finally, this study lever-ages the robust data gathering and follow-up protocols of NSQIP as well as the extremely low rates of study attrition (2.6% of living participants at 3 months, and 8.5% at 6 months) with geriatrician-performed chart adjudications.

The limitations of this study include the self-report aspects of baseline and follow-up data, with the potential for subjective interpretation. Although self-report was previously shown to be a reliable source of data, particularly for short time periods,³⁸ there is the potential for recall bias. We attempted to control for this by performing chart review to corroborate follow-up reports. The survey administered to patients and caregivers allowed for subjective interpretation by patients and caregivers. Particularly strong follow-up data decreased the likelihood of attrition bias, and a sensitivity analysis was performed to address attrition bias secondary to death.

Overall, this study adds to the current body of literature in hip fracture patients in many ways. We demonstrated the importance of dementia and in-hospital delirium in predicting new or worsened disability in patients who were previously functionally independent. We also showed that opiate prescription at the time of admission was predictive of the development of ADL disability, raising concerns for the high proportion of patients in the community prescribed these medications. Lastly, we demonstrated an improvement in mobility between 3- and 6-month followup, placing importance of future investigations on recovery optimization during this time frame.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

Financial Disclosure: Yale HRSA GWEP U1QHP28745.

REFERENCES

1. Cree M, Soskolne CL, Belseck E, et al. Mortality and institutionalization following hip fracture. *J Am Geriatr Soc.* 2000;48(3):283–288. [PubMed: 10733054]
2. Fransen M, Woodward M, Norton R, Robinson E, Butler M, Campbell AJ. Excess mortality or institutionalization after hip fracture: men are at greater risk than women. *J Am Geriatr Soc.* 2002;50(4):685–690. [PubMed: 11982669]
3. Cenzer IS, Tang V, Boscardin WJ, et al. One-year mortality after hip fracture: development and validation of a prognostic index. *J Am Geriatr Soc.* 2016;64(9):1863–1868. [PubMed: 27295578]
4. Marottoli RA, Berkman LF, Cooney LM Jr. Decline in physical function following hip fracture. *J Am Geriatr Soc.* 1992;40(9):861–866. [PubMed: 1512379]
5. Magaziner J, Hawkes W, Hebel JR, et al. Recovery from hip fracture in eight areas of function. *J Gerontol A Biol Sci Med Sci.* 2000;55(9):M498–M507. [PubMed: 10995047]
6. Sahota O, Currie C. Hip fracture care: all change. *Age Ageing.* 2008;37(2): 128–129. [PubMed: 18349006]
7. Dyer SM, Crotty M, Fairhall N, et al. A critical review of the long-term disability outcomes following hip fracture. *BMC Geriatr.* 2016;16:158. [PubMed: 27590604]
8. Griffiths F, Mason V, Boardman F, et al. Evaluating recovery following hip fracture: a qualitative interview study of what is important to patients. *BMJ Open.* 2015;5(1):e005406.
9. Mariconda M, Costa GG, Cerbasi S, et al. Factors predicting mobility and the change in activities of daily living after hip fracture: a 1-year prospective cohort study. *J Orthop Trauma.* 2016;30(2):71–77. [PubMed: 26817573]
10. Fukui N, Watanabe Y, Nakano T, Sawaguchi T, Matsushita T. Predictors for ambulatory ability and the change in ADL after hip fracture in patients with different levels of mobility before injury: a 1-year prospective cohort study. *J Orthop Trauma.* 2012;26(3):163–171. [PubMed: 21918484]
11. Semel J, Gray JM, Ahn HJ, Nasr H, Chen JJ. Predictors of outcome following hip fracture rehabilitation. *PM&R.* 2010;2(9):799–805. [PubMed: 20869677]
12. McGilton KS, Chu CH, Naglie G, van Wyk PM, Stewart S, Davis AM. Factors influencing outcomes of older adults after undergoing rehabilitation for hip fracture. *J Am Geriatr Soc.* 2016;64(8):1601–1609. [PubMed: 27351370]
13. Smith AK, Cenzer IS, John Boscardin W, Ritchie CS, Wallhagen ML, Covinsky KE. Increase in disability prevalence before hip fracture. *J Am Geriatr Soc.* 2015;63(10):2029–2035. [PubMed: 26480970]
14. Gialanella B, Ferlucci C, Monguzzi V, Prometti P. Determinants of outcome in hip fracture: role of daily living activities. *Eur J Phys Rehabil Med.* 2015; 51(3):253–260. [PubMed: 25427525]
15. Gonzalez-Zabaleta J, Pita-Fernandez S, Seoane-Pillado T, Lopez-Calvino B, Gonzalez-Zabaleta JL. Dependence for basic and instrumental activities of daily living after hip fractures. *Arch Gerontol Geriatr.* 2015;60(1):66–70. [PubMed: 25465506]
16. Uriz-Otano F, Uriz-Otano JI, Malafarina V. Factors associated with short-term functional recovery in elderly people with a hip fracture. Influence of cognitive impairment. *J Am Med Dir Assoc.* 2015;16(3):215–220. [PubMed: 25441099]
17. Givens JL, Sanft TB, Marcantonio ER. Functional recovery after hip fracture: the combined effects of depressive symptoms, cognitive impairment, and delirium. *J Am Geriatr Soc.* 2008;56(6):1075–1079. [PubMed: 18422945]
18. Krogseth M, Watne LO, Juliebo V, et al. Delirium is a risk factor for further cognitive decline in cognitively impaired hip fracture patients. *Arch Gerontol Geriatr.* 2016;64:38–44. [PubMed: 26952375]
19. Krogseth M, Wyller TB, Engedal K, Juliebo V. Delirium is a risk factor for institutionalization and functional decline in older hip fracture patients. *J Psychosom Res.* 2014;76(1):68–74. [PubMed: 24360144]

20. Caro CC, Costa JD, Da Cruz DMC. Burden and quality of life of family caregivers of stroke patients. *Occup Ther Health Care*. 2018;32:1–18. [PubMed: 29351518]
21. Ransmayr G, Hermann P, Sallinger K, et al. Caregiving and caregiver burden in dementia home care: results from the prospective dementia registry (PRODEM) of the Austrian Alzheimer Society. *J Alzheimers Dis*. 2018;63:103–114. [PubMed: 29614643]
22. Wolff JL, Mulcahy J, Huang J, Roth DL, Covinsky K, Kasper JD. Family caregivers of older adults, 1999–2015: trends in characteristics, circumstances, and role-related appraisal. *Gerontologist*. 2018;58:1021–1032. [PubMed: 28637266]
23. Hoffman GJ, Wallace SP. The cost of caring: economic vulnerability, serious emotional distress, and poor health behaviors among paid and unpaid family and friend caregivers. *Res Aging*. 2018;40:791–809. [PubMed: 29202659]
24. Grigoryan KV, Javedan H, Rudolph JL. Orthogeriatric care models and outcomes in hip fracture patients: a systematic review and meta-analysis. *J Orthop Trauma*. 2014;28(3):e49–e55. [PubMed: 23912859]
25. Becker DJ, Arora T, Kilgore ML, et al. Trends in the utilization and outcomes of Medicare patients hospitalized for hip fracture, 2000–2008. *J Aging Health*. 2014;26(3):360–379. [PubMed: 24401322]
26. Dodd AC, Bulka C, Jahangir A, Mir HR, Obremskey WT, Sethi MK. Predictors of 30-day mortality following hip/pelvis fractures. *Orthop Traumatol Surg Res*. 2016;102(6):707–710. [PubMed: 27496661]
27. Fansa A, Huff S, Ebraheim N. Prediction of mortality in nonagenarians following the surgical repair of hip fractures. *Clin Orthop Surg*. 2016;8(2):140–145. [PubMed: 27247737]
28. Porter CJ, Moppett IK, Juurlink I, Nightingale J, Moran CG, Devonald MA. Acute and chronic kidney disease in elderly patients with hip fracture: prevalence, risk factors and outcome with development and validation of a risk prediction model for acute kidney injury. *BMC Nephrol*. 2017;18(1):20. [PubMed: 28088181]
29. Robertson L, Black C, Fluck N, et al. Hip fracture incidence and mortality in chronic kidney disease: the GLOMMS-II record linkage cohort study. *BMJ Open*. 2018;8(4):e020312.
30. Suh YS, Won SH, Choi HS, et al. Survivorship and complications after hip fracture surgery in patients with chronic kidney disease. *J Korean Med Sci*. 2017;32(12):2035–2041. [PubMed: 29115088]
31. Liu Y, Wang Z, Xiao W. Risk factors for mortality in elderly patients with hip fractures: a meta-analysis of 18 studies. *Aging Clin Exp Res*. 2018;30(4):323–330. [PubMed: 28660596]
32. Sim YE, Sim SD, Seng C, Howe TS, Koh SB, Abdullah HR. Preoperative anemia, functional outcomes, and quality of life after hip fracture surgery. *J Am Geriatr Soc*. 2018;66:1524–1531. [PubMed: 30091139]
33. Hong SE, Kim TY, Yoo JH, et al. Acute kidney injury can predict in-hospital and long-term mortality in elderly patients undergoing hip fracture surgery. *PLoS One*. 2017;12(4):e0176259. [PubMed: 28426743]
34. Inouye SK, Leo-Summers L, Zhang Y, Bogardus ST Jr, Leslie DL, Agostini JV. A chart-based method for identification of delirium: validation compared with interviewer ratings using the confusion assessment method. *J Am Geriatr Soc*. 2005;53(2):312–318. [PubMed: 15673358]
35. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegel AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113(12):941–948. [PubMed: 2240918]
36. Saczynski JS, Kosar CM, Xu G, et al. A tale of two methods: chart and interview methods for identifying delirium. *J Am Geriatr Soc*. 2014;62(3):518–524. [PubMed: 24512042]
37. Tang VL, Sudore R, Cenzer IS, et al. Rates of recovery to prefracture function in older persons with hip fracture: an observational study. *J Gen Intern Med*. 2017;32(2):153–158. [PubMed: 27605004]
38. Short ME, Goetzel RZ, Pei X, et al. How accurate are self-reports? An analysis of self-reported healthcare utilization and absence when compared to administrative data. *J Occup Environ Med*. 2009;51(7):786–796. [PubMed: 19528832]

Table 1.

Baseline Characteristics

	All patients (n = 184)	Survivors at 6 months (n = 147)	Decedents at 6 months (n = 26)	P value (survivors vs decedents)
Age, y	83.7 ± 8.09	82.3 ± 7.72	88.0 ± 8.45	.001
Female sex	125 (67.9%)	99 (74.4%)	16 (61.5%)	.179
Nonwhite race	11 (6.0%)	8 (6.0%)	1 (3.9%)	1.000
Married	70 (38.0%)	50 (37.6%)	9 (34.6%)	.083
Hospital LOS, d	5.5 ± 3.41	5.1 ± 2.15	7.2 ± 6.57	.003
Time to surgery	1.4 ± 1.54	1.3 ± 1.10	1.4 ± 1.63	.233
Fracture type				.325
Femoral neck	100 (54.4%)	70 (52.6%)	17 (65.4%)	
Intertrochanteric	79 (42.9%)	60 (45.1%)	8 (30.8%)	
Other	5 (2.7%)	3 (2.3%)	1 (3.9%)	
Procedure				.201
ORIF	118 (64.1%)	86 (64.7%)	18 (69.2%)	
HA/THR	66 (35.9%)	47 (35.3%)	8 (30.8%)	
Comorbidities				
Dementia	39 (21.2%)	13 (9.8%)	5 (19.2%)	.179
CHF	35 (19.0%)	26 (19.6%)	10 (38.5%)	.035
CKD	34 (18.5%)	24 (18.1%)	7 (26.9%)	.296
Depression	20 (10.9%)	29 (21.8%)	2 (7.7%)	.112
No. of medications	7.9 ± 4.56	8.0 ± 4.66	8.8 ± 4.36	.425
Hemoglobin	12.3 ± 1.83	12.5 ± 1.76	11.3 ± 2.00	.001
Creatinine	1.1 ± .93	1.1 ± .95	1.3 ± .94	.329
Hospital delirium	44 (23.9%)	28 (21.1%)	10 (38.5%)	.057
ICU during admission	18 (9.8%)	8 (6.0%)	6 (23.1%)	.005
Medications at admission				
Benzodiazepines	32 (17.4%)	19 (14.3%)	7 (26.9%)	.111
Opiates	19 (10.3%)	16 (12.0%)	3 (11.5%)	>.999
Antipsychotics	5 (2.7%)	4 (3.0%)	0 (0)	>.999
Tramadol	18 (9.8%)	15 (11.3%)	2 (7.7%)	.741

	All patients (n = 184)	Survivors at 6 months (n = 147)	Decedents at 6 months (n = 26)	P value (survivors vs decedents)
Antidepressants	109 (59.2%)	38 (28.6)	2 (7.7)	.026
Postdischarge opiates	109 (59.2%)	88 (64.7%)	10 (38.5%)	.012

Abbreviations: CHF, congestive heart failure; CKD, chronic kidney disease; HA, hemiarthroplasty; ICU, intensive care unit; LOS, length of stay; ORIF, open reduction and internal fixation; THR, total hip replacement.

Table 2.

Activity of Daily Living, Mobility Dependence, and Care Hour Needs

	P value 3-6 months		
	Baseline (n = 184)	3 months (n = 161)	6 months (n = 147)
Bathing	0 (0)	45 (28.0)	34 (23.1)
Dressing	0 (0)	26 (16.1)	18 (12.2)
Toileting	0 (0)	23 (14.3)	16 (10.9)
Eating	0 (0)	4 (2.5)	2 (1.4)
No ADL dependency	184 (100)	115 (71.4)	113 (76.9)
1 or more ADL dependency	0 (0)	46 (28.6)	34 (23.1)
Dependent: 1 ADL	0 (0)	19 (11.8)	15 (10.2)
Dependent: 2 ADLs	0 (0)	6 (3.7)	4 (2.7)
Dependent: 3 ADLs	0 (0)	17 (10.6)	13 (8.8)
Dependent: 4 ADLs	0 (0)	4 (2.5)	2 (1.4)
	Baseline (n = 184)	3 months (n = 161)	6 months (n = 147)
Ambulation	1 (.5)	19 (11.8)	11 (7.5)
Stairs	15 (8.2)	61 (37.9)	45 (30.6)
Two blocks	21 (13.0)	75 (46.6)	52 (35.4)
Transfer from bed/chair	0 (0)	21 (13.0)	13 (8.8)
No mobility dependency	160 (87.0)	78 (48.5)	84 (57.1)
1 or more mobility dependency	24 (13.0)	83 (51.5)	63 (42.9)
Dependent: 1 mobility item	12 (6.5)	30 (18.6)	29 (19.7)
Dependent: 2 mobility items	11 (5.8)	31 (19.3)	21 (14.3)
Dependent: 3 mobility items	1 (.5)	4 (2.5)	2 (1.4)
Dependent: 4 mobility items	0 (0)	18 (11.2)	11 (7.5)
	Baseline (n = 150)	3 months (n = 161)	6 months (n = 147)
Care hours received			
0	125 (83.4)	85 (52.8)	87 (59.2)
1-4	19 (12.7)	34 (21.1)	33 (22.3)
5-8	4 (2.7)	8 (5.0)	8 (5.4)
9-12	0 (0)	7 (4.3)	2 (1.4)

Abbreviation: ADL, activity of daily living.
Data expressed as n (%).

	18 (12.2)	27 (16.8)	2 (1.3)	>12
<i>P</i> value 3–6 months				

Table 3.

Unadjusted and Adjusted Models for New Activity of Daily Living Disability at 3 and 6 Months

	Unadjusted OR(<i>P</i> value)	Adjusted OR(<i>P</i> value)	Sensitivity analysis OR(<i>P</i> value)
3 Months			
Age	1.08 (.002)	1.04 (.153)	1.02 (.433)
Female sex	1.67 (.194)	1.59 (.348)	1.92 (.149)
Nonwhite race	.94 (.932)	.86 (.856)	1.26 (.772)
Admission hemoglobin	1.28 (.024)	1.39 (.014)	1.15 (.196)
Dementia	13.29 (<.001)	11.81 (.001)	4.42 (.009)
Delirium	6.67 (<.001)	4.20 (.002)	3.46 (.002)
6 Months			
Age	1.11 (<.001)	1.09 (.014)	1.06 (.082)
Female sex	2.69 (.042)	3.13 (.062)	3.39 (.028)
Nonwhite race	.77 (.743)	.89 (.909)	1.48 (.680)
Dementia	9.43 (<.001)	9.91 (.001)	5.33 (.004)
Delirium	5.25 (<.001)	3.00 (.031)	3.49 (.008)
Opiate prescription at admission	3.17 (.035)	7.72 (.003)	7.71 (.001)

Abbreviation: OR, odds ratio.

Table 4.

Unadjusted and Adjusted Models for Worsened Mobility at 3 and 6 Months

	Unadjusted OR (<i>P</i> value)	Adjusted OR (<i>P</i> value)	Sensitivity analysis OR(<i>P</i> value)
3 Months			
Age	1.05 (.021)	1.02 (.259)	1.01 (.398)
Female sex	1.55 (.203)	1.58 (.251)	1.87 (.083)
Nonwhite race	1.41 (.585)	1.15 (.848)	1.86 (.354)
Delirium	4.03 (.001)	4.58 (.001)	2.90 (.005)
No. of medications	1.11 (.004)	1.13 (.003)	1.12 (.002)
6 Months			
Age	1.08 (.001)	1.11 (.001)	1.06 (.027)
Female sex	1.31 (.485)	1.24 (.639)	1.81 (.157)
Nonwhite race	1.85 (.348)	2.33 (.264)	2.74 (.141)
Delirium	3.10 (.019)	3.10 (.019)	2.46 (.029)
No. of medications	1.13 (.013)	1.13 (.013)	1.09 (.040)
Opiate prescription at admission	6.75 (.002)	7.23 (.005)	5.26 (.006)

Abbreviation: OR, odds ratio.

Table 5.

Unadjusted and Adjusted Models for Increased Care Hours Received at 3 and 6 Months

	Unadjusted OR (<i>P</i> value)	Adjusted OR (<i>P</i> value)	Sensitivity analysis OR (<i>P</i> value)
3 Months			
Age	1.07 (.003)	1.07 (.014)	1.04 (.069)
Female sex	1.80 (.125)	1.70 (.212)	2.06 (.071)
Nonwhite race	1.52 (.525)	1.93 (.369)	2.64 (.174)
No. of medications	1.10 (.017)	1.13 (.004)	1.11 (.045)
Delirium	2.73 (.015)	2.36 (.058)	1.99 (.084)
6 Months			
Age	1.06 (.022)	1.06 (.017)	1.04 (.084)
Female sex	1.94 (.113)	1.27 (.610)	1.55 (.337)
Nonwhite race	1.32 (.699)	1.36 (.41)	1.58 (.540)
No. of medications	1.11 (.010)	1.22 (.013)	1.10 (.028)
Depression	2.27 (.052)	2.32 (.085)	2.48 (.051)
Tramadol at discharge	2.06 (.063)	2.25 (.061)	2.17 (.059)

Abbreviation: OR, odds ratio.