Published in final edited form as:
JAMA Intern Med. 2014 August 1; 174(8): 1273–1280. doi:10.1001/jamainternmed.2014.2362.

Survival and functional outcomes after hip fracture among nursing home residents

Mark D. Neuman, MD[1,2], **Jeffrey H. Silber, MD, PhD**[1,2,3,4,5], **Jay S. Magaziner, PhD**[6], **Molly A. Passarella, MS**[3], **Samir Mehta, MD**[7], and **Rachel M. Werner, MD, PhD**[2,8]

[1]Department of Anesthesiology and Critical Care, Perelman School of Medicine at the University of Pennsylvania

[2]Leonard Davis Institute for Health Economics, the University of Pennsylvania

[3]Center for Outcomes Research, Children's Hospital of Philadelphia

[4]Department of Pediatrics, Perelman School of Medicine at the University of Pennsylvania

[5]Health Care Management Department, the Wharton School, the University of Pennsylvania

[6]Department of Epidemiology and Public Health, University of Maryland School of Medicine

[7]Department of Orthopedic Surgery, Perelman School of Medicine at the University of Pennsylvania

[8]Department of Internal Medicine, Division of General Internal Medicine, Perelman School of Medicine at the University of Pennsylvania

Abstract

Importance—Little is known regarding outcomes after hip fracture among long-term nursing home residents.

Objective—To describe patterns and predictors of mortality and functional decline in activities of daily living (ADLs) among nursing home residents after hip fracture.

Design—Retrospective cohort study.

Corresponding Author Address: Mark D. Neuman, M.D., M.Sc., Department of Anesthesiology and Critical Care, Perelman School of Medicine at the University of Pennsylvania, 423 Guardian Drive, 1119A Blockley Hall, Philadelphia, PA 19104, Office: (215) 746-7468, Fax: (215) 349-5078, neumanm@mail.med.upenn.edu.

Author contributions: Dr. Neuman had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Neuman, Silber, Magaziner, Mehta, Werner.
Acquisition of data: Neuman, Werner.
Analysis and interpretation of data: Neuman, Silber, Magaziner, Mehta, Werner.
Drafting of the manuscript: Neuman, Werner.
Critical revision of the manuscript for important intellectual content: Neuman, Silber, Magaziner, Mehta, Werner.
Statistical analysis: Neuman, Passarella.
Obtained funding: Neuman.
Study supervision: Neuman, Werner, Magaziner.

Conflict of Interest Disclosure: During the past three years, Dr, Magaziner has consulted or served on advisory boards for the American Orthopaedic Association, Amgen, Ammonett, Eli Lilly, Glaxo SmithKline, Organext, and Regeneron, and received research funds through contract with the University of Maryland from Eli Lilly. The remaining authors have no conflicts to disclose.

Setting—U.S. long-term nursing homes.

Participants—Medicare beneficiaries residing in nursing homes who were hospitalized with hip fractures between July 1, 2005 and June 30, 2009.

Main Outcomes and Measures—Data sources included Medicare claims and the Nursing Home Minimum Data Set. Main outcomes included death from any cause at 180 days after fracture and a composite outcome of death or new total dependence in locomotion at the latest available assessment within 180 days. Additional analyses described within-subjects changes in function in seven ADLs before and after fracture.

Results—Out of 60,111 patients, 21,766 (36.2%) died by 180 days after fracture; among patients not totally dependent in locomotion at baseline, 53.5% died or developed new total dependence within 180 days. Within individual subjects, function declined substantially after fracture across all ADL domains assessed. In adjusted analyses, the greatest decreases in survival after fracture occurred with age over 90 (versus 75 or below: HR 2.17, 95% CI: 2.09, 2.26, P<0.001), non-operative fracture management (versus internal fixation: hazard ratio for death (HR) 2.08; 95% CI: 2.01, 2.15, P<0.001), and advanced comorbidity (Charlson score of 5 or more versus Charlson score of 0: HR 1.66, 95% CI: 1.58, 1.73, P<0.001). The combined risk of death or new total dependence in locomotion within 180 days was greatest among patients with very severe cognitive impairment (versus intact cognition: RR 1.66; 95% CI: 1.56, 1.77, P<0.001), patients receiving non-operative management (versus internal fixation: RR 1.48; 95% CI: 1.45, 1.51, P<0.001), and patients over 90 years old (versus 75 or below: RR 1.42; 95% CI: 1.37, 1.46, P<0.001).

Conclusions and Relevance—Survival and functional outcomes are poor after hip fracture among nursing home residents, particularly for patients receiving non-operative management, the oldest-old, and patients with multiple comorbidities and advanced cognitive impairment. Care planning should incorporate appropriate prognostic information related to outcomes in this population.

BACKGROUND

Hip fractures occur over 300,000 times each year among older U.S. adults,[1, 2] resulting in substantial mortality[3, 4] and loss of functional independence.[5, 6] Residents of long-term nursing homes are twice as likely as community-dwelling individuals to sustain a hip fracture[7-9] and outcomes after fracture are worse among nursing home residents than among community-dwellers.[10-12] Nonetheless, past cohort studies of hip fracture have commonly excluded nursing home residents.[4, 5, 13-15] Moreover, studies that have focused on nursing home residents with hip fractures have been limited by small sample sizes,[12, 16, 17] single-center designs,[18-20] and lack of data on functional outcomes.[17, 18] As a result, little is currently known about patterns and predictors of mortality and functional decline among nursing home residents with hip fractures.

We undertook a retrospective cohort study to examine outcomes among all fee-for-service Medicare beneficiaries who were hospitalized with an acute hip fracture between July 1, 2005 and June 30, 2009 and who were living in a nursing home prior to fracture. Our study had three goals: first, we aimed to characterize patterns of survival and new total dependence in locomotion among nursing home residents at six months and a year after hip fracture; second, we sought to describe within-subjects changes in functional dependence in seven activities of daily living before and after fracture; finally, we aimed to identify risk factors associated with survival after hip fracture, and with a composite outcome of death or new, total dependence in locomotion within 180 days after fracture.

METHODS

Data sources

This study was approved by the Institutional Review Boards of the Perelman School of Medicine and The Children's Hospital of Philadelphia. Our dataset merged the following administrative and clinical data sources: (1) the 2005-2009 Long Term Care Minimum Data Set (MDS), which contains standardized, validated clinical assessments completed by nurses for all residents in Medicare- or Medicaid-certified U.S. nursing homes at the time of admission and at specified intervals thereafter;[21-24] (2) the 2005-2009 100% Medicare Provider Analysis and Review (MedPAR) files, which include claims for inpatient hospital care for all fee-for-service Medicare beneficiaries; and (3) the 2005-2009 Medicare Beneficiary Summary File, which records HMO enrollment and vital status information. Beneficiaries were linked across files using an encrypted unique identifier.

Study sample

To identify Medicare beneficiaries who were hospitalized with an acute hip fracture and were residents in a long-term nursing home prior to hospitalization, we first identified all beneficiaries who had a hospital discharge record with a principal or secondary discharge diagnosis code indicating an acute femoral neck, intertrochanteric, or subtrochanteric fracture (International Classification of Disease-9-Clinical Modification (ICD-9-CM) diagnosis codes 820.00-09, 820.01-19, 820.21-2, 820.31-2, 820.8-9) between July 1, 2005 and June 30, 2009. To ensure that we included only acute admissions for hip fracture, rather than readmissions, we considered the first recorded hip fracture admission to be the index, and we excluded from our sample any patient hospitalized for hip fracture between July 1, 2005 and December 31, 2005 who had been hospitalized for hip fracture in the preceding 180 days.

We next identified patients who were residents in long-term nursing homes prior to fracture. As all Medicare- and Medicaid-certified nursing homes are required to complete MDS assessments of residents at admission and at intervals no greater than 92 days thereafter, we followed prior investigators in using the presence of two MDS assessments within an appropriate interval as an indicator of nursing home residence.[25-27] Specifically, we selected all individuals with two or more routine quarterly assessments in the MDS or an MDS admission assessment followed by a quarterly assessment in the 184 days before the index hospitalization. We considered MDS assessments conducted for changes in clinical status or to correct errors in earlier assessments to be equivalent to quarterly assessments.

Independent variables: baseline characteristics and acute fracture management

We collected data from MedPAR files on patient age, sex, and race, which we coded as black, white and other.[28] As in previous work, we used ICD-9-CM diagnosis codes to create indicator variables for the anatomic location of the fracture (femoral neck, intertrochanteric, subtrochanteric, or multiple locations).[29] We used ICD-9-CM procedure codes (see Appendix, eTable 1) to identify receipt of surgical hip fracture treatment via total hip arthroplasty, hemiarthroplasty, or internal fixation during the index admission. We considered patients without an ICD-9-CM code for any of the above treatments to have received non-operative management. We used validated algorithms to identify 16 Charlson comorbidities[30] based on ICD-9-CM diagnosis codes for all hospitalizations in the 180 days prior to the index admission and information on chronic medical conditions recorded in the last MDS assessment prior to admission.[30, 31]

We collected data from the MDS on self-performance in activities of daily living (ADL) using each individual's last MDS quarterly assessment prior to the index admission. Following past investigations that have used MDS data to measure changes over time in ADL function,[25-27,32] we obtained information regarding baseline self-performance in seven ADLs: (1) locomotion on the nursing home unit; (2) dressing; (3) personal hygiene; (4) using the toilet; (5) transferring between surfaces; (6) getting in and out of bed; and (7) eating. Detailed descriptions of these ADL domains appear in the Appendix (eTable 2).

For each ADL domain, MDS assessors graded resident self-performance as observed across all nursing shifts over a seven day period. Grading used a five-point scale with the following categories: "independent;" "supervision;" "limited assistance;" "extensive assistance;" and "total dependence." Within the MDS, "independence" in a given ADL indicated the ability to perform that activity without help or oversight, or requiring help or oversight only one or two times over seven days; "total dependence" indicated the need for full staff performance of that activity for all seven days. For this analysis, patients for whom a particular ADL did not occur over seven days were classified as being totally dependent in that domain. A detailed description of the MDS ADL self-performance grading scale appears in the Appendix (eTable 3).

To obtain a measure of baseline cognitive status, we used the MDS Cognitive Performance Scale (CPS).[33] The CPS is a validated measure that grades cognition on a 7-point scale ranging from "intact" to "very severe impairment" based on MDS items describing cognition over a 7 day period. Increasing CPS values correlate highly with decreasing scores on the Folstein Mini-Mental Status Exam.[33,34] As with pre-fracture ADL assessments, baseline CPS scores were obtained from the last available MDS assessment prior to the index admission.

Outcome variables

Our primary outcome was death from any cause within 180 days of hospital admission. Additionally, we examined post-fracture self performance for each of the seven above ADLs as recorded in the last available MDS assessment within 180 days after the index admission. Following past investigations of survival and locomotion outcomes after hip fracture,[16,35] we also created a composite outcome of death by 180 days or new total dependence in locomotion at the last available assessment within 180 days among all patients who were not totally dependent in locomotion at baseline. Among individuals for whom we had at least 365 days of follow-up data (i.e. those hospitalized between July 1, 2005 and December 31, 2008), we also examined mortality at 365 days and a composite outcome of death by 365 days or new total dependence in locomotion at the latest available assessment within 365 days.

Statistical analyses

Initial analyses used descriptive statistics and Kaplan-Meier survival curves to characterize baseline features and outcomes among the full study sample and separately among men and women. To assess within-subjects changes in ADL function before and at 180 days after fracture, we examined the distribution of post-fracture MDS self-performance scores within each ADL domain among patients with the same level of baseline self-performance in that ADL. To account for deaths, these analyses added a sixth outcome category, corresponding to death within 180 days, to the five-level MDS self-performance scale.[36] Patients who survived to 180 days after hospital admission but had no recorded post-fracture MDS assessments (362 patients, 0.6% of the study sample) were included in our calculations for 180-day mortality but excluded from calculations related to 180-day functional outcomes; we took an analogous approach in analyzing 365-day outcomes.

We developed a multivariate Cox proportional hazards model to measure the adjusted association of baseline patient factors and acute fracture management with post-fracture survival, considering the survival time to be right-censored for all patients who were alive as of December 31, 2009. As a supplementary analysis, we also developed a regression model to predict a binary outcome of death at 180 days; this model used multivariate Poisson regression with robust variance estimates[38,39,40] to measure the adjusted relative risks of mortality associated with specific patient factors and fracture management approaches. Finally, to measure the adjusted association of baseline patient factors and acute fracture management with the composite outcome (death or new, total dependence in locomotion within 180 days), we estimated adjusted relative risks using a multivariate Poisson regression model with robust variance estimates.

We chose variables for inclusion in our regression models based on clinical judgment and literature review. They were: age, sex, race, Charlson comorbidity index score,[30] fracture location, fracture management approach (internal fixation, hemiarthroplasty, total hip arthroplasty, or non-operative management), baseline cognitive performance, baseline locomotion self-performance, and the number out of six non-locomotion ADLs with independent self-performance at baseline. While the survival model and the 180-day mortality model each included all patients in our study sample, the model for our composite outcome excluded those individuals who were totally dependent in locomotion at baseline. As longitudinal studies of health that exclude decedents may produce misleading results,[36,37] we did not carry out regression analyses restricted to patients who survived to 180 days after hip fracture. Analyses used SAS 9.3 (SAS institute, Cary, NC, 2010). We used a value of $p<0.05$ to indicate statistical significance.

RESULTS

Out of 724,699 fee-for-service Medicare beneficiaries hospitalized with a hip fracture over the study period, 60,111 (8.3%) were nursing home residents. Among these individuals, the median time between the last pre-fracture MDS assessment and the index admission was 39 days (interquartile range, 18 days to 63 days). Among patients who survived to 180 days after fracture, the median number of days between the index admission and the last available MDS assessment within 180 days was 128 days (interquartile range, 103 days to 166 days); within this group, the timing of the last available MDS assessment ranged from 3 days to 180 days after admission.

Long-term nursing home patients with hip fracture had a high degree of baseline comorbidity, ADL dependence, and cognitive impairment (Table 1). Within the overall sample, 26.6% had a Charlson score of 4 or greater. At the last available MDS assessment prior to admission, 31.0% of the sample was independent in locomotion but only 5.8% of the sample was independent in 6 out of 6 non-locomotion ADLs. 9.3% were cognitively intact at baseline. 11.8% of patients had no evidence of surgical hip fracture treatment during the index hospitalization. Baseline characteristics differed between men and women in our sample; while men more often had high degrees of comorbidity, women demonstrated a higher degree of dependence in locomotion (see Appendix; eTable 4).

Out of 60,111 patients in our full sample, 21,766 (36.2%) died by 180 days after fracture (Figure 1; Table 2). Median survival time after fracture was 377 days (interquartile range, 70 days to 1,002 days). Of the 52,734 patients who were not totally dependent in locomotion at baseline, 28,225 (53.5%) either died or were newly dependent in locomotion within 180 days; among patients who survived to 180 days, new, total dependence in locomotion occurred in 9,438 of 33,947 (27.8%).

Among the 52,914 patients with at least one year of available follow-up data, 24,883 (47.0%) died by 365 days. Among the 46,842 of these patients who were not totally dependent in locomotion at baseline, 28,114 (60.5%) either died or experienced new total dependence in locomotion within 365 days. Among the 24,984 patients without total dependence in locomotion at baseline who had at least 365 days of follow up data and who survived 365 days after fracture, 6,618 (26.5%) were totally dependent in locomotion at 365 days.

Outcomes differed according to sex; compared to females, death by 180 days and the 180-day composite outcome each occurred more frequently among males. Dependence in locomotion also occurred frequently among patients who died within 180 days of fracture; among the 16,153 decedents who had at least one post-fracture ADL measurement, 90% were either totally dependent or required extensive assistance in locomotion at the last available assessment prior to death.

Within individual subjects, differences in the degree of independence in locomotion before and after fracture varied according to baseline locomotion status (Figure 1). Among patients who were fully independent in locomotion at baseline, 21.0% both survived to 180 days and were independent in locomotion at their last available assessment within 180 days. Among patients who required supervision in locomotion at baseline and among those who required limited assistance for locomotion at baseline, 16.2% and 22.1% both survived to 180 days and attained or exceeded their pre-fracture level of independence in locomotion by the last available assessment within 180 days (Figure 2). Marked within-subjects changes in ADL self-performance also occurred in transferring between surfaces, mobility in bed, dressing, personal hygiene, and toileting; smaller changes occurred in ADL self-performance related to eating (see Appendix; eFigure 1).

In our proportional hazards model, male sex, increasing age, white race, and high levels of comorbidity, cognitive impairment, locomotion dependence, and dependence in non-locomotion ADLs were all significantly associated with decreases in adjusted post-fracture survival. Decreased survival was also seen among patients with non-femoral neck fractures, patients undergoing hemiarthroplasty or total hip arthroplasty versus internal fixation, and patients who received non-operative management (Table 3). The factors most strongly associated with decreased survival after fracture were age over 90 (versus 75 or below: HR 2.17, 95% CI: 2.09, 2.26, P<0.001), non-operative fracture management (versus internal fixation: hazard ratio (HR) 2.08; 95% CI: 2.01, 2.15, P<0.001), and a Charlson score of five or more (versus zero: HR 1.66, 95% CI: 1.58, 1.73, P<0.001). We obtained qualitatively similar results from a multivariate Poisson regression model that used the same set of independent variables to predict a binary outcome of death at 180 days (see Appendix, eTable 5).

Most factors associated with decreased adjusted survival were also associated with an increased adjusted risk of our composite outcome of death or new, total dependence in locomotion within 180 days, although black patients were at slightly elevated risk of experiencing this outcome compared to whites (relative risk (RR) 1.05, 95% CI 1.02, 1.09, P=0.002). In our Poisson regression model, the factors most strongly associated with the composite adverse outcome were very severe cognitive impairment (versus intact cognition: RR 1.66; 95% CI: 1.56, 1.77, P<0.001), non-operative fracture management (versus internal fixation: RR 1.48; 95% CI: 1.45, 1.51, P<0.001), and age over 90 (versus 75 or younger: RR 1.42; 95% CI: 1.37, 1.46, P<0.001).

CONCLUSIONS

In this study of 60,111 U.S. long-term nursing home residents, hip fractures were associated with substantial mortality and increases in ADL dependence. By 180 days after fracture, more than one in three patients had died, including nearly one out of every two men. Among those individuals who had some degree of functional independence in locomotion at baseline, one out of two had either died or developed new total dependence in locomotion within 180 days after fracture.

Hip fractures were associated with profound increases in dependence in multiple activities of daily living. Among patients who were fully independent in locomotion at baseline or required supervision or limited assistance, approximately one in five survived to regain their pre-fracture level of independence in locomotion at 180 days after fracture; similar patterns were observed for other ADLs, including transferring, mobility in bed, personal hygiene, and toileting.

Finally, we identified several risk factors for adverse outcomes after hip fracture among nursing home residents. We classified 11.8% of patients in our sample as having received non-operative management, a rate approximately twice that seen in the overall Medicare population.[41] Within our cohort, non-operative care was associated with marked decreases in survival after hip fracture and a substantially greater adjusted risk of death or new total dependence in locomotion within 180 days compared to internal fixation. While this finding may be due in part to the sickest patients electing to undergo non-operative management, it would also be consistent with a substantial negative effect of non-operative care on outcomes. Beyond non-operative fracture management, male sex, increasing age, white race, high levels of comorbidity, advanced cognitive impairment, non-femoral neck fracture location, and increasing baseline ADL dependence were all associated with decreased survival after hip fracture. Most of these same factors were also associated with a significantly elevated risk of the composite outcome of death or new total dependence in locomotion within 180 days, although we did observe black patients to be at a slightly higher risk of experiencing the composite outcome compared to white patients. Overall, the presence of very severe cognitive impairment at baseline was associated with the greatest increase in the risk of this outcome.

Poor outcomes among long-term nursing home residents with hip fracture have previously been noted in small cohort studies[12, 16,17] and single-center investigations.[18,19,20] For example, in a study of 195 long-term care residents from a single U.S. institution who experienced a hip fracture between 1999 and 2006, Berry and colleagues noted an overall mortality rate of 40% at 1 year.[18] Similarly, among 60 ambulatory nursing home patients with hip fracture in Canada in 2008 and 2009, Beaupre and colleagues noted a 45% mortality rate and a combined rate of death or new inability to ambulate of 63% at 1 year.[16] Among 38 patients with end-stage dementia and hip fracture, the majority of whom were long-term nursing home residents, Morrison and Siu reported a 6-month mortality of 55%.[20]

Our study confirms and extends these prior findings. To our knowledge, ours is the largest and most comprehensive study to date of outcomes following hip fracture among nursing home residents. By taking advantage of a large, national dataset, this study provides a reliable and highly generalizable description of the experiences of nursing home residents who experience hip fractures. Further, it provides important insight into the heterogeneous nature of hip fracture as a clinical syndrome. While past investigators have identified selected risk factors for adverse outcomes after hip fracture in general,[10,11] our findings offer new evidence regarding specific baseline risk factors for adverse outcomes at 180 days among nursing home residents who experience hip fractures.

Our study has limitations. Since MedPAR files do not contain records on HMO patients, we were unable to identify HMO patients with hip fracture. While our study dataset contained detailed clinical information on the patients in our sample, we cannot rule out unobserved differences in severity of illness that may have partially explained differences in outcomes we observe across groups of patients, such as those receiving operative versus non-operative care. As we did not examine the effect of post-acute care services on outcomes, we cannot comment here on the impact of variations in the quality of post-fracture nursing home care on survival or functional recovery. Further, since additional recovery may have occurred beyond the date of each patient's latest available MDS assessment, our analyses may underestimate the true extent of functional recovery at 180 days. Finally, as our composite outcome incorporates information on both survival and post-fracture locomotion, it should not be interpreted as a measure of the relative likelihood of new dependence in locomotion after fracture *per se*; rather, it is a more general indicator of the likelihood of an adverse health outcome, defined here as death or the development of new, total dependence within 180 days after fracture.

Despite these limitations, our findings have important implications for clinical practice and health care delivery. Residents of long-term nursing facilities represent a uniquely vulnerable subset of all hip fracture patients, and approaches to clinical care for these individuals should consider the high probability of death and functional disability after fracture in this group. In particular, the extreme rates of mortality and functional disability documented here suggest that counseling regarding prognosis for survival and recovery, explicit discussions of goals of care, and aggressive efforts to control pain and other distressing symptoms represent essential components of management for nursing home residents with hip fracture. At the same time, our observation of substantially worse risk-adjusted outcomes among patients receiving non-operative management suggests that indicated operative fracture treatment may be reasonable even in the presence of advanced comorbidity, cognitive impairment, or baseline functional dependence if it is consistent with patients' overall goals of care. More generally, our findings emphasize the importance of continued efforts to prevent hip fractures among nursing home residents; finally, they stress the need for further research on the potential for quality improvement initiatives, potentially including specialized inpatient geriatric fracture programs, to improve outcomes among nursing home residents who sustain hip fractures.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding/Support: Mark D. Neuman received funding from the National Institute on Aging (K08AG043548-02).

Role of the Sponsor: The National Institute on Aging had no role in the design or conduct of the study; the collection, management, analysis, or interpretation of data; or the preparation, review, or approval of the manuscript.

REFERENCES

1. Hall MJ, DeFrances CJ, Williams SN, Gololinsky A, Schwartzman A. National Hospital Discharge Survey: 2007 Summary. National Health Statistics Reports. Oct 26.2010 (29)
2. Blackman DK, Kamimoto LA, Smith SM. Overview: surveillance for selected public health indicators affecting older adults--United States. MMWR CDC Surveill Summ. Dec 17; 1999 48(8): 1–6.
3. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. JAMA. Oct 14; 2009 302(14):1573–1579. [PubMed: 19826027]
4. Magaziner J, Lydick E, Hawkes W, et al. Excess mortality attributable to hip fracture in white women aged 70 years and older. Am J Public Health. Oct; 1997 87(10):1630–1636. [PubMed: 9357344]

5. Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. J Gerontol. May; 1990 45(3):M101–107. [PubMed: 2335719]
6. Magaziner J, Hawkes W, Hebel JR, et al. Recovery from hip fracture in eight areas of function. J Gerontol A Biol Sci Med Sci. Sep; 2000 55(9):M498–507. [PubMed: 10995047]
7. Norton R, Campbell AJ, Reid IR, et al. Residential status and risk of hip fracture. Age Ageing. Mar; 1999 28(2):135–139. [PubMed: 10350409]
8. Butler M, Norton R, Lee-Joe T, Cheng A, Campbell AJ. The risks of hip fracture in older people from private homes and institutions. Age Ageing. Sep; 1996 25(5):381–385. [PubMed: 8921144]
9. Brennan nee Saunders J, Johansen A, Butler J, et al. Place of residence and risk of fracture in older people: a population-based study of over 65-year-olds in Cardiff. Osteoporos Int. Jul; 2003 14(6): 515–519. [PubMed: 12730755]
10. Eastwood EA, Magaziner J, Wang J, et al. Patients with hip fracture: subgroups and their outcomes. J Am Geriatr Soc. Jul; 2002 50(7):1240–1249. [PubMed: 12133019]
11. Penrod JD, Litke A, Hawkes WG, et al. Heterogeneity in hip fracture patients: age, functional status, and comorbidity. J Am Geriatr Soc. Mar; 2007 55(3):407–413. [PubMed: 17341244]
12. Beaupre LA, Cinats JG, Jones CA, et al. Does functional recovery in elderly hip fracture patients differ between patients admitted from long-term care and the community? J Gerontol A Biol Sci Med Sci. Oct; 2007 62(10):1127–1133. [PubMed: 17921426]
13. Taylor BC, Schreiner PJ, Stone KL, et al. Long-term prediction of incident hip fracture risk in elderly white women: study of osteoporotic fractures. J Am Geriatr Soc. Sep; 2004 52(9):1479–1486. [PubMed: 15341549]
14. Richmond J, Aharonoff GB, Zuckerman JD, Koval KJ. Mortality risk after hip fracture. J Orthop Trauma. Jan; 2003 17(1):53–56. [PubMed: 12499968]
15. Marottoli RA, Berkman LF, Leo-Summers L, Cooney LM Jr. Predictors of mortality and institutionalization after hip fracture: the New Haven EPESE cohort. Established Populations for Epidemiologic Studies of the Elderly. Am J Public Health. Nov; 1994 84(11):1807–1812. [PubMed: 7977922]
16. Beaupre LA, Jones CA, Johnston DW, Wilson DM, Majumdar SR. Recovery of function following a hip fracture in geriatric ambulatory persons living in nursing homes: prospective cohort study. J Am Geriatr Soc. Jul; 2012 60(7):1268–1273. [PubMed: 22702238]
17. Cameron ID, Chen JS, March LM, et al. Hip fracture causes excess mortality owing to cardiovascular and infectious disease in institutionalized older people: a prospective 5-year study. J Bone Miner Res. Apr; 2010 25(4):866–872. [PubMed: 19839771]
18. Berry SD, Samelson EJ, Bordes M, Broe K, Kiel DP. Survival of aged nursing home residents with hip fracture. J Gerontol A Biol Sci Med Sci. Jul; 2009 64(7):771–777. [PubMed: 19414511]
19. Crotty M, Miller M, Whitehead C, Krishnan J, Hearn T. Hip fracture treatments--what happens to patients from residential care? J Qual Clin Pract. Dec; 2000 20(4):167–170. [PubMed: 11207957]
20. Morrison RS, Siu AL. Survival in end-stage dementia following acute illness. JAMA. Jul 5; 2000 284(1):47–52. [PubMed: 10872012]
21. Brown, DL., editor. Center for Medicare and Medicaid Services Revised Long-Term Care Resident Assessment Instrument User’s Manual, Version 2.0. Briggs Corporation; West Des Moines, IA: 2003.
22. Hawes C, Morris JN, Phillips CD, Mor V, Fries BE, Nonemaker S. Reliability estimates for the Minimum Data Set for nursing home resident assessment and care screening (MDS). Gerontologist. Apr; 1995 35(2):172–178. [PubMed: 7750773]
23. Casten R, Lawton MP, Parmelee PA, Kleban MH. Psychometric characteristics of the minimum data set I: confirmatory factor analysis. J Am Geriatr Soc. Jun; 1998 46(6):726–735. [PubMed: 9625189]
24. Lawton MP, Casten R, Parmelee PA, Van Haitsma K, Corn J, Kleban MH. Psychometric characteristics of the minimum data set II: validity. J Am Geriatr Soc. Jun; 1998 46(6):736–744. [PubMed: 9625190]
25. Finlayson E, Wang L, Landefeld CS, Dudley RA. Major abdominal surgery in nursing home residents: a national study. Ann Surg. Dec; 2011 254(6):921–926. [PubMed: 22020197]

26. Finlayson E, Zhao S, Boscardin WJ, Fries BE, Landefeld CS, Dudley RA. Functional status after colon cancer surgery in elderly nursing home residents. J Am Geriatr Soc. May; 2012 60(5):967–973. [PubMed: 22428583]
27. Kurella Tamura M, Covinsky KE, Chertow GM, Yaffe K, Landefeld CS, McCulloch CE. Functional status of elderly adults before and after initiation of dialysis. N Engl J Med. Oct 15; 2009 361(16):1539–1547. [PubMed: 19828531]
28. Arday SL, Arday DR, Monroe S, Zhang J. HCFA's racial and ethnic data: current accuracy and recent improvements. Health Care Financ Rev. 2000 Summer;21(4):107–116. [PubMed: 11481739]
29. Neuman MD, Silber JH, Elkassabany NM, Ludwig JM, Fleisher LA. Comparative effectiveness of regional versus general anesthesia for hip fracture surgery in adults. Anesthesiology. Jul; 2012 117(1):72–92. [PubMed: 22713634]
30. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987; 40(5):373–383. [PubMed: 3558716]
31. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care. Nov; 2005 43(11):1130–1139. [PubMed: 16224307]
32. Morris JN, Fries BE, Morris SA. Scaling ADLs within the MDS. J Gerontol A Biol Sci Med Sci. Nov; 1999 54(11):M546–553. [PubMed: 10619316]
33. Morris JN, Fries BE, Mehr DR, et al. MDS Cognitive Performance Scale. J Gerontol. Jul; 1994 49(4):M174–182. [PubMed: 8014392]
34. Hartmaier SL, Sloane PD, Guess HA, Koch GG, Mitchell CM, Phillips CD. Validation of the Minimum Data Set Cognitive Performance Scale: agreement with the Mini-Mental State Examination. J Gerontol A Biol Sci Med Sci. Mar; 1995 50(2):M128–133. [PubMed: 7874589]
35. Hannan EL, Magaziner J, Wang JJ, et al. Mortality and locomotion 6 months after hospitalization for hip fracture: risk factors and risk-adjusted hospital outcomes. JAMA. Jun 6; 2001 285(21):2736–2742. [PubMed: 11386929]
36. Diehr P, Johnson LL, Patrick DL, Psaty B. Methods for incorporating death into health-related variables in longitudinal studies. J Clin Epidemiol. Nov; 2005 58(11):1115–1124. [PubMed: 16223654]
37. Rothman, K.; Greenland, S.; Lash, T., editors. Modern Epidemiology. 3rd ed.. Lippincott, Williams, and Wilkins; Philadelphia: 2008.
38. McNutt LA, Wu C, Xue X, Hafner JP. Estimating the relative risk in cohort studies and clinical trials of common outcomes. Am J Epidemiol. May 15; 2003 157(10):940–943. [PubMed: 12746247]
39. Greenland S. Model-based estimation of relative risks and other epidemiologic measures in studies of common outcomes and in case-control studies. Am J Epidemiol. Aug 15; 2004 160(4):301–305. [PubMed: 15286014]
40. Zou G. A modified poisson regression approach to prospective studies with binary data. Am J Epidemiol. Apr 1; 2004 159(7):702–706. [PubMed: 15033648]
41. Neuman MD, Fleisher LA, Even-Shoshan O, Mi L, Silber JH. Nonoperative care for hip fracture in the elderly: the influence of race, income, and comorbidities. Med Care. Apr; 2010 48(4):314–320. [PubMed: 20355262]

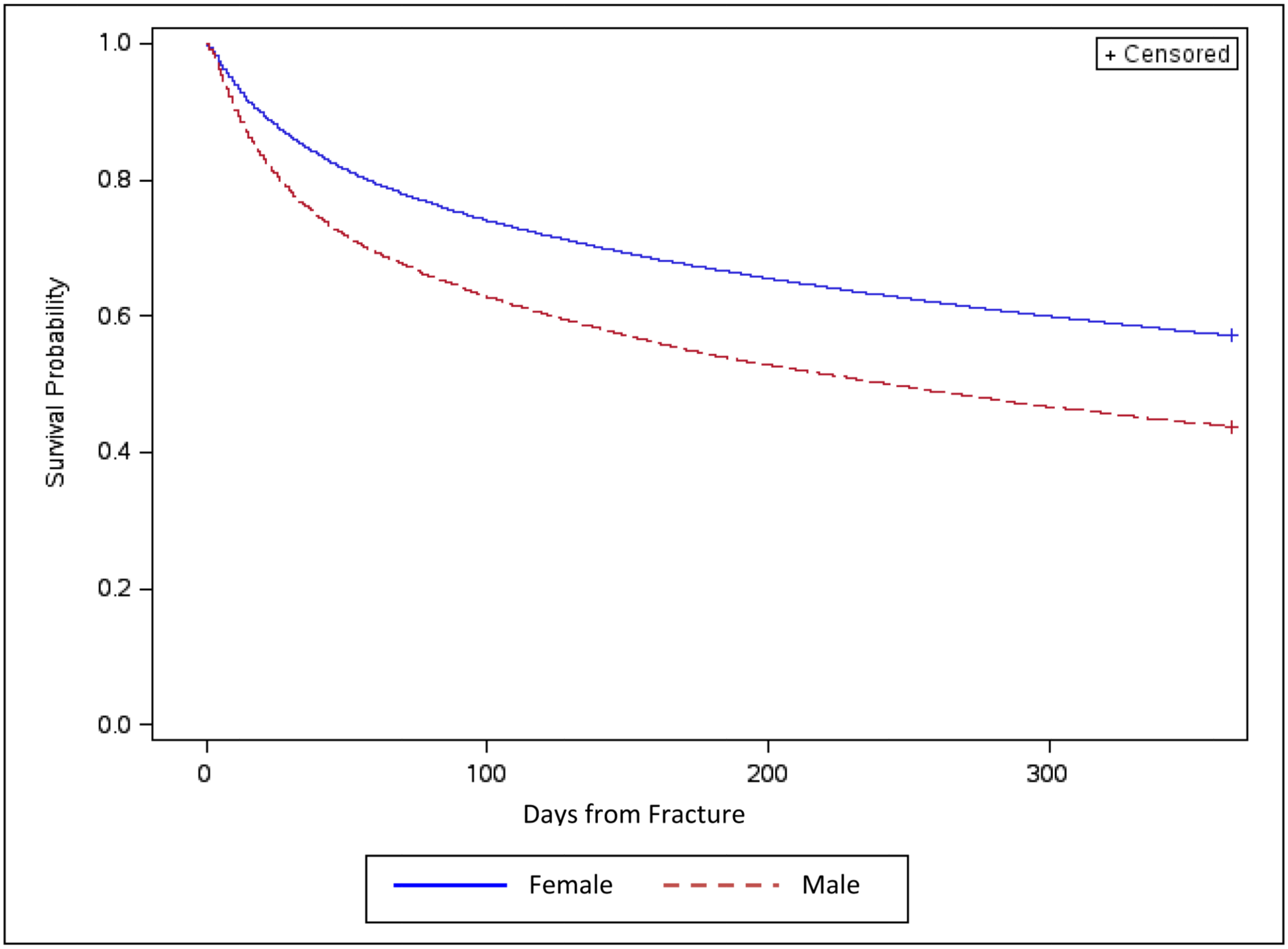

Figure 1.

Survival at up to 365 days among 60,111 U.S. long-term care residents hospitalized with hip fracture between July 1, 2005 and June 30, 2009. Male patients demonstrate a lower probability of survival than women at all time points after fracture (p<0.001 by log-rank test).

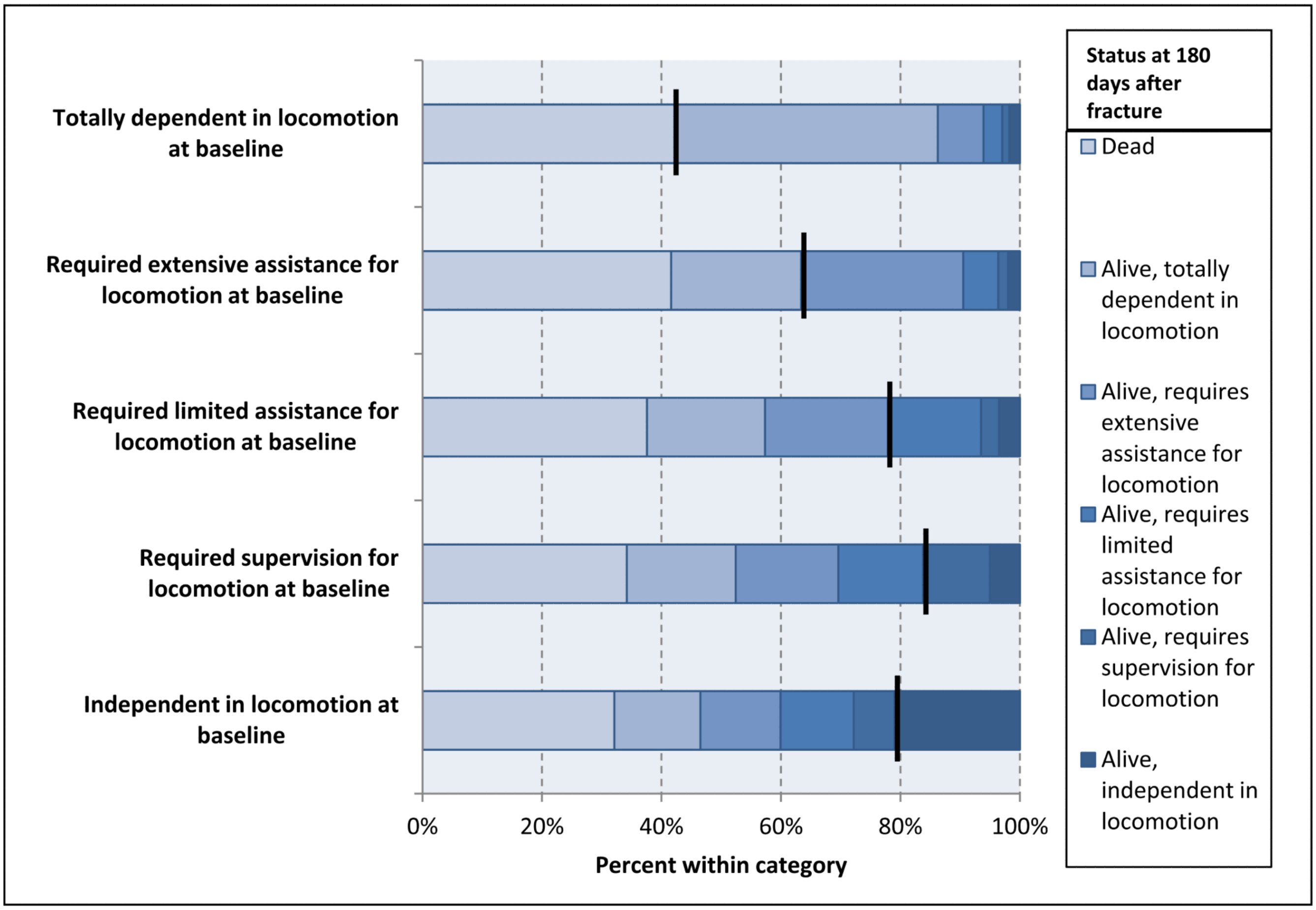

Figure 2.
180-day survival and within-subjects changes in locomotion self-performance among 59,749 nursing home residents hospitalized with hip fractures between July 1, 2005 and June 30, 2009. For individuals within a given category of baseline locomotion self-performance, the corresponding horizontal bar shows the fraction of patients who died within 180 days, along with the distribution of post-fracture locomotion scores at the last available assessment within 180 days among survivors. The bold vertical line intersecting each bar demarcates the fraction of individuals within a baseline locomotion category who both survived to 180 days and regained or exceeded their baseline level of locomotion self-performance at the latest available assessment within 180 days after fracture.

Table 1

60,111 long-term U.S. nursing home residents hospitalized with hip fractures between July 1, 2005 and June 30, 2009: baseline characteristics and acute fracture management.

		N (%)
Sex		
	Female	45,345 (75.44)
	Male	14,766 (24.56)
Age		
	75 or younger	6,662 (11.08)
	76-80	8,408 (13.99)
	81-85	14,343 (23.86)
	86-90	15,930 (26.5)
	91 or older	14,768 (24.57)
Race		
	White	55,241 (91.90)
	Black	3,335 (5.55)
	Other	1,535 (2.55)
Charlson score		
	0	4,967 (8.26)
	1	15,228 (25.33)
	2	13,918 (23.15)
	3	10,027 (16.68)
	4	6,551 (10.90)
	5 or more	9,420 (15.67)
Baseline cognitive performance		
	Intact	5,586 (9.29)
	Borderline intact	5,600 (9.32)
	Mild impairment	10,120 (16.84)
	Moderate impairment	25,296 (42.08)
	Moderate-severe impairment	6,340 (10.55)
	Severe impairment	5,889 (9.80)
	Very severe impairment	1,280 (2.13)
Baseline dependence in locomotion		
	Independent	18,638 (31.01)
	Requires supervision	12,022 (20.00)
	Requires limited assistance	12,497 (20.79)
	Requires extensive assistance	9,884 (16.44)
	Total dependence	7,070 (11.76)
Number out of 6 non-locomotion activities of daily living with functional independence[a]		

		N (%)
	6	3,503 (5.83)
	4-5	5,743 (9.55)
	2-3	11,263 (18.74)
	0-1	39,602 (65.88)
Fracture location		
	Femoral neck	28,380 (47.21)
	Intertrochanteric	25,535 (42.48)
	Subtrochanteric	2,088 (3.47)
	Multiple locations	4,108 (6.83)
Acute fracture management		
	Hemiarthroplasty	18,760 (31.21)
	Internal fixation	33,273 (55.35)
	Total hip arthroplasty	1,009 (1.68)
	Non-operative management	7,069 (11.76)

[a]Activities assessed include: bed mobility, transferring, dressing, personal hygiene, eating, and toileting.

Table 2

Study outcomes

	All (%)	Female (%)	Male (%)	P (male vs. female)
Death at 180 days[a]	21,766/60,111 (36.2)	15,009/45,345 (33.1)	6,757/14,766 (45.8)	<0.001
Death or new total disability in locomotion at 180 days[b]	28,225/52,734 (53.5)	20,517/39,508 (51.9)	7,708/13,226 (58.3)	<0.001

[a]Sample includes all patients in starting cohort;

[b]Sample includes all patients without total dependence in locomotion at baseline and all patients who either died by 180 days or who survived to 180 days and had a valid MDS assessment in the first 180 days following admission.

Table 3

Predictors of adverse outcomes after hip fracture among nursing home residents

		Adjusted hazard ratio for survival after admission for hip fracture (95% confidence interval)[a]	P	Adjusted relative risk for death or new total disability in locomotion at 180 days after hip fracture (95% confidence interval)[b]	P
Sex					
	Female	Reference		Reference	
	Male	1.54 (1.51, 1.58)	<0.001	1.14 (1.12, 1.16)	<0.001
Age					
	75 or younger	Reference		Reference	
	76-80	1.20 (1.15, 1.25)	<0.001	1.08 (1.05, 1.13)	<0.001
	81-85	1.40 (1.34, 1.45)	<0.001	1.18 (1.14, 1.22)	<0.001
	86-90	1.65 (1.59, 1.72)	<0.001	1.26 (1.22, 1.30)	<0.001
	91 or older	2.17 (2.09, 2.26)	<0.001	1.42 (1.37, 1.46)	<0.001
Race					
	White	Reference		Reference	
	Black	0.77 (0.73, 0.80)	<0.001	1.05 (1.02, 1.09)	0.002
	Other	0.74 (0.70, 0.79)	<0.001	0.94 (0.90, 0.99)	0.030
Charlson score					
	0	Reference		Reference	
	1	1.10 (1.05, 1.15)	<0.001	1.05 (1.02, 1.09)	0.0047
	2	1.22 (1.17, 1.28)	<0.001	1.06 (1.03, 1.10)	<0.001
	3	1.35 (1.29, 1.41)	<0.001	1.11 (1.07, 1.15)	<0.001
	4	1.44 (1.37, 1.51)	<0.001	1.13 (1.09, 1.18)	<0.001
	5 or more	1.66 (1.58, 1.73)	<0.001	1.20 (1.16, 1.25)	<0.001
Baseline cognitive performance					
	Intact	Reference		Reference	
	Borderline intact	1.01 (0.96, 1.06)	0.652	1.01 (0.97, 1.05)	0.632
	Mild impairment	1.09 (1.05, 1.14)	<0.001	1.07 (1.04, 1.11)	<0.001
	Moderate impairment	1.14 (1.10, 1.19)	<0.001	1.18 (1.14, 1.22)	<0.001
	Moderate-severe impairment	1.22 (1.17, 1.28)	<0.001	1.34 (1.29, 1.40)	<0.001
	Severe impairment	1.29 (1.23, 1.35)	<0.001	1.42 (1.37, 1.47)	<0.001
	Very severe impairment	1.16 (1.07, 1.25)	<0.001	1.66 (1.56, 1.77)	<0.001
Baseline dependence in locomotion					
	Independent	Reference		Reference	
	Requires supervision	1.02 (0.99, 1.05)	0.253	1.02 (1.00, 1.05)	0.051

		Adjusted hazard ratio for survival after admission for hip fracture (95% confidence interval)[a]	**P**	**Adjusted relative risk for death or new total disability in locomotion at 180 days after hip fracture (95% confidence interval)[b]**	**P**
	Requires limited assistance	1.08 (1.04, 1.11)	<0.001	1.09 (1.06, 1.11)	<0.001
	Requires extensive assistance	1.16 (1.12, 1.20)	<0.001	1.16 (1.13, 1.19)	<0.001
	Total dependence	1.12 (1.08, 1.17)	<0.001	N/A	
Number out of 6 non-locomotion activities of daily living with functional independence at baseline[c]					
	6	Reference		Reference	
	4-5	1.13 (1.07, 1.19)	<0.001	1.17 (1.11, 1.23)	<0.001
	2-3	1.23 (1.17, 1.30)	<0.001	1.30 (1.24, 1.37)	<0.001
	0-1	1.27 (1.20, 1.33)	<0.001	1.30 (1.24, 1.37)	<0.001
Fracture location					
	Femoral neck	Reference		Reference	
	Intertrochanteric	1.10 (1.07, 1.13)	<0.001	1.10 (1.07, 1.12)	<0.001
	Subtrochanteric	1.09 (1.02, 1.15)	0.006	1.18 (1.12, 1.23)	<0.001
	Multiple locations	1.13 (1.08, 1.18)	<0.001	1.13 (1.10, 1.17)	<0.001
Acute fracture management					
	Internal fixation	Reference		Reference	
	Total hip arthroplasty	1.15 (1.06, 1.25)	<0.001	1.10 (1.03, 1.18)	0.003
	Hemiarthroplasty	1.10 (1.07, 1.14)	<0.001	1.12 (1.10, 1.15)	<0.001
	Non-operative management	2.08 (2.01, 2.15)	<0.001	1.48 (1.45, 1.51)	<0.001

Notes:

[a]Sample includes all patients in starting cohort; N=60,111.

[b]Sample includes all patients without total dependence in locomotion at baseline and all patients who either died by 180 days or who survived to 180 days and had a valid MDS assessment in the first 180 days following admission (N=52,734)

[c]Activities assessed include: bed mobility, transferring, dressing, personal hygiene, eating, and toileting.