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Residual Disability, Mortality, and Nursing Home Placement after Hip Fracture over Two Decades

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Abstract

Objective: To examine trends in 12-month post-fracture residual disability, nursing home placement, and mortality among patients with a hip fracture between 1990 and 2011.

Design: Secondary analysis of 12-month outcomes from three cohort studies and control arms of two randomized controlled trials.

Setting: Original studies were conducted as part of the Baltimore Hip Studies (BHS).

Participants: Community-dwelling patients 65 years of age hospitalized for surgical repair of a non-pathological hip fracture (n=988).

Main Outcomes: 12-month residual disability, mortality, and nursing home residency were examined in case-mix adjusted models by sex and study. Residual disability was calculated by subtracting pre-fracture scores of Lower Extremity Physical Activities of Daily Living from scores at 12-months post fracture. We also examined the proportion of individuals with a 12-month score higher than their pre-fracture score (residual disability >0).

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DSA, EB, GVO, JRH, JG, ALG-B, MCH, and BR have no conflicts of interest to disclose. JMG reports personal fees from Pluristem Pharma, Boeringer-Ingelheim, and Viking Therapeutics. DLO reports consulting agreements with Viking Therapeutics, Inc. and Kinexum. JSM reports personal fees from Pluristem, Novartis, Viking, Ammonett, Sanofi, and Scholar Rock.

Results: Only small improvements were seen in residual disability between 1990 and 2011. No significant differences were seen for men between BHS2 (enrollment 1990–1991; mean residual disability=3.1 activities, 95% CI: 2.16, 4.10) and BHS7 (enrollment 2006–2011; mean=3.1 activities, 95% CI: 2.41, 3.82). In women, residual disability significantly improved from BHS2 (mean=3.5 activities, 95% CI: 2.95, 3.99) to BHS3 (enrollment 1992–1995; mean=2.7 activities, 95% CI: 2.01, 3.30) with no significant improvements in later studies. After adjustment, a substantial proportion (91% of men and 79% of women) had a negative outcome (residual disability, died, or nursing home residence at 12 months) in the most recently completed study (BHS7).

Conclusions: Over two decades, patients undergoing usual care post-hip fracture still had substantial residual disability. Additional clinical and research efforts are needed to determine how to improve hip fracture treatment, rehabilitation, and subsequent outcomes.

Keywords

Hip Fractures; Rehabilitation; Disability Evaluation; Outcome Assessment

INTRODUCTION

Hip fractures are a burdensome geriatric health problem. In 2010, over 250,000 older adults (≥ 65 years of age) were hospitalized for a hip fracture.¹ Additionally, due to aging of the population, the number of hip fractures is expected to increase almost 12% in the United States between 2010 and 2030.² Hip fracture patients have significant increases in disability, mortality, and nursing home admission over the 12-months post fracture, compared to age-matched controls.³ Patients also have an increased risk of subsequent hospitalizations.⁴ For those 65 and over, in 2005, the cost for hip fractures accounting for inpatient, outpatient, and long-term care was over 11 billion dollars.⁵

The recovery process after a hip fracture can take many months.⁶ Many patients do not reach their pre-fracture levels of mobility and independence.⁷ With respect to activities of daily living, 30%–75% of patients fail to return to their pre-fracture levels.^{8–10} Outcomes may also differ by sex.¹¹

Mortality, nursing home residency, and disability after fracture has been frequently studied^{12–18}. While secular trends in mortality^{12–16} and nursing home residency^{12,14} at 12-months after fracture have been examined, no study, to our knowledge, has investigated secular trends in disability among hip fracture survivors. Given the increasing burden and costly nature of hip fractures, it is important to understand whether outcomes among patients have improved over time given the potential for increases in disability attributable to hip fracture in the population. Due to changes in surgical management¹⁴, policy¹⁹, and extensive research on rehabilitation approaches²⁰ over the last few decades, this study examined trends in residual disability, mortality, and nursing home placement among hip fracture patients between 1990 and 2011 using data from five longitudinal studies conducted in a metropolitan area.

METHODS

Study Sample

The Baltimore Hip Studies (BHS) began in 1983 to study outcomes in older adults with hip fractures. The BHS assessed recovery among hip fracture patients within five cohort studies (BHS1⁹, BHS2⁶, BHS3²¹, BHS6²², BHS7²³) and two randomized controlled trials (BHS4²⁴ and BHS5²⁵). These studies were approved by the Institutional Review Boards of the University and the individual study hospitals where recruitment took place. Informed consent was obtained from participants and/or their proxies.

Two of the BHS cohort studies (BHS1 and BHS6) were excluded from this secondary analysis because the primary outcome, Lower Extremity Physical Activities of Daily Living (LPADL) was not collected. All subjects from BHS2 (n=486), BHS3 (n=150), and BHS7 (n=233) were included. To focus on the natural history of hip fracture recovery for those receiving usual care, only those in the usual care arms of the randomized controlled trials (BHS4 [n=76] and BHS5 [n=44]) were included in the secondary analysis (i.e., intervention group was excluded).

Details of the design, enrollment period, entry criteria, sample composition, follow-up, and objectives of the five studies included in this secondary analysis are displayed in Table 1. All studies enrolled individuals who were community-dwelling and admitted to the hospital for surgical repair of a non-pathologic hip fracture. Only two studies included men (BHS2 and BHS7).

Outcome Measures

The LPADL is a measure of lower extremity disability specifically adapted for hip fracture patients from the Functional Status Index.²⁶ The same questionnaire was used for all studies. Subjects were asked if they performed and received help performing twelve activities (walk 10 feet, walk 1 block, climb 5 stairs, get into car, get in/out of bed, rise from an armless chair, put on pants, put on socks/shoes, get into/out of bath/shower, wash all parts of body, get on/off toilet, reach for item on ground). Responses for each activity were: no help, used equipment, used human assistance, used equipment and human assistance, did not perform due to health reasons, and did not perform due to non-health reasons.⁶ The LPADL score for each individual was the count of the number of activities in which a person was disabled, defined as needing equipment and/or human assistance or not performing a given task for a health reason. LPADL scores range from 0 to 12 with higher scores indicating more disability.

At baseline (<22 days post-hip fracture), individuals were asked to self-report the level of assistance needed in the week prior to fracture. At the 12-month post-fracture interview, survivors were asked, regardless of whether they resided in the community or not, to self-report on the level of assistance used over the past week. BHS2, BHS3, and BHS7 allowed patient and proxy responses for the LPADL question; patient data was preferentially used for analyses.

Within each study, residual disability was calculated by comparing pre-fracture LPADL scores to LPADL scores 12-months post-fracture. Residual disability was assessed both in terms of mean intra-individual change in LPADL score and whether an individual had a worse 12-month post-fracture LPADL score (higher score) than the pre-fracture score (proportion). Twelve-month mortality (proportion) and the proportion of subjects residing in a nursing home at 12-months post-fracture were calculated. Nursing home placement was determined by where the individual was residing at the 12-month post-fracture interview. Two composite outcomes were assessed. The first was the proportion who had a higher 12-month post-fracture LPADL score than pre-fracture or had died by 12 months (composite outcome one). Composite outcome two was the proportion who met the criteria for composite outcome one or who resided in a nursing home at 12-months post-fracture.

Covariates

Variables examined included age, race, marital status, education, Mini-Mental State Examination (MMSE)²⁷ score, body mass index (BMI), type of fracture (intertrochanteric or any other type), type of surgery (internal fixation or arthroplasty), length of stay, initial hospitalization discharge location, comorbidities, and pre-fracture LPADL score. In one study (BHS7), the Modified Mini-Mental State (3MS) examination²⁸ was used instead of the MMSE; for consistency, 3MS scores were converted to MMSE score equivalents.²⁸

The comorbidities assessed differed across studies, so those analyzed were restricted to the 15 common comorbidities captured across the studies (heart problems, arthritis, cancer, cirrhosis/substance abuse, respiratory disease, dementia/Alzheimer's, diabetes, epilepsy/seizures, ulcers, hypertension, osteoporosis/Paget's disease, Parkinson disease, peripheral vascular disease, and stroke). Comorbidity level was the count of the number of conditions (out of 15) an individual endorsed.

Statistical Methods

Analysis was conducted in SAS v9.4 (Cary, NC). Descriptive analysis was conducted stratified by BHS study. As men and women may have differing outcomes after fracture, studies were further stratified by sex.^{29,30} ANOVA and Chi-squared tests were used to examine differences across BHS studies by sex.

Crude proportions were calculated for residual disability, mortality, and nursing home placement at 12 months for those with non-missing respective outcome data. Chi-squared tests were used to compare outcomes across studies by sex. Ordinary least squares regression was used to fit a linear regression model comparing mean residual disability (LPADL at 12-months post-fracture – LPADL pre-fracture) across the cohorts, including a sex interaction term. To account for case-mix and entry criteria differences across studies that may affect the outcomes, the comparisons were subsequently case-mix adjusted for age, count of comorbidities, body mass index, fracture type, and MMSE score. To facilitate interpretability, all continuous covariates were standardized. An analogous, case-mix adjusted logistic regression model was used for the comparison of the proportion of subjects with composite outcome one and two. All odds ratios and 95% confidence interval estimates were converted to proportions [$\hat{p}$ =odds ratio/(1+odds ratio)].

To evaluate which particular activities contributed most to residual disability, pooled mean intra-individual differences between LPADL scores 12-months post-fracture and pre-fracture for each LPADL item were calculated by sex.

RESULTS

Table 2 displays the distributions of socio-demographic and clinical characteristics stratified by study and sex. Across cohorts, significant differences ($p < 0.05$) were seen for women in age, race, marital status, education, comorbidity count, MMSE, BMI, length of stay, discharge location, and baseline LPADL. Significant differences ($p < 0.05$) in men between BHS2 and BHS7 were present for the same characteristics, except race and marital status.

Table 3 displays the proportion experiencing the single and composite outcome measures across the five BHS studies prior to case-mix adjustment (crude). For men, there were no significant differences ($p < 0.05$) between BHS2 and BHS7 for any of the outcomes. For women, significant differences ($p < 0.05$) were found across studies for residual disability, nursing home placement, and both composite outcomes. There was no significant difference across studies for mortality. For BHS2, 15.9% of women died by 12-months post-fracture while, for BHS7, 11.4% died. Among survivors, 88.1% had residual disability and 24.9% were residing in nursing homes, compared to 11.4% and 7.9% for BHS7.

Figure 1 shows the mean level of residual disability at 12-months for each study plotted by study, stratified by sex, and adjusted for case-mix (age, comorbidities, MMSE, BMI, and surgery type). In BHS2, women had residual disability in an average of 3.5 activities (95% CI: 2.95, 3.99). Compared to BHS2, there was significantly less residual disability present in BHS3 (mean=2.7 activities, 95% CI: 2.01, 3.30), BHS4 (mean=2.3, 95% CI: 1.54, 3.10), and BHS7 (mean=2.7, 95% CI: 1.64, 2.90). There was no significant difference between the amount of residual disability in BHS2 and BHS5 (mean=3.0, 95% CI: 1.95, 4.01) nor were BHS3, BHS4, BHS5, and BHS7 significantly different from one another. For men, there was no significant difference between BHS2 (mean=3.1, 95% CI: 2.16, 4.10) and BHS7 (mean=3.1, 95% CI: 2.41, 2.82).

The case-mix adjusted proportion of subjects with 12-month residual disability or death (composite outcome one) by study year and sex is displayed in Figure 2. Similar to residual disability, women saw significant improvements from BHS2 ($\hat{p}=0.87$, 95% CI: 0.83, 0.89) to BHS3 ($\hat{p}=0.76$, 95% CI: 0.71, 0.81), to BHS4 ($\hat{p}=0.69$, 95% CI: 0.62, 0.75), and to BHS7 ($\hat{p}=0.76$, 95% CI: 0.71, 0.80) but not to BHS5 ($\hat{p}=0.80$, 95% CI: 0.72, 0.86). There were no significant differences between BHS3, BHS4, BHS5, and BHS7. Men saw no significant improvements between BHS2 ($\hat{p}=0.86$, 95% CI: 0.80, 0.90) and BHS7 ($\hat{p}=0.90$, 95% CI: 0.87, 0.93).

Sex- and study-stratified case-mix adjusted proportions of subjects with residual disability or death or nursing home residency at 12 months (composite outcome two) is displayed in Figure 3. Again, males saw no significant improvements between BHS2 ($\hat{p}=0.88$, 95% CI: 0.85, 0.90) and BHS7 ($\hat{p}=0.91$, 95% CI: 0.87, 0.93). Females saw significant improvement from BHS2 ($\hat{p}=0.88$, 95% CI: 0.85, 0.90) to BHS3 ($\hat{p}=0.78$, 95% CI: 0.73, 0.82) and to

BHS4 ($\hat{p}=0.71$, 95% CI: 0.65, 0.77). There were no significant pairwise differences between any other studies, including BHS5 ($\hat{p}=0.82$, 95% CI: 0.74, 0.87) and BHS7 ($\hat{p}=0.79$, 95% CI: 0.74, 0.83).

Among those with LPADL measures at baseline and 12 months, men had most pronounced increases in disability in getting on and off the toilet (52.0%), walking 1 block (35.1%) and getting in and out of the bath (34.5%). Females had the largest increases in disability in getting on and off the toilet (45.1%), getting in and out of the bath (36.7%), and climbing 5 stairs (36.1%).

DISCUSSION

This secondary analysis of five hip fracture studies found that over the course of two decades (1990 to 2011), patients still have substantial residual disability 12 months after fracture, with only slight improvements in outcomes from BHS2 (1990–1991 enrollment) to BHS7 (2006–2011 enrollment). In the most recent study (BHS7), after case-mix adjustment, women and men, 12 months after fracture, had additional disability in 2.5 and 3.1 additional activities, respectively, compared to pre-fracture. In BHS7, after adjustment, 79% of women and 91% of men had a negative outcome (greater disability, died, or nursing home residence at 12-months post-fracture). Women had slight reductions in these negative outcomes between 1990 and 2001, but men did not.

The crude, 12-month mortality for the analyzed studies ranged from 5.3%–15.9% for women and 29.4–38.0% for men. Mortality after fracture is associated with older age, male sex, and more comorbidities.^{7,15,31} The lowest 12-month, unadjusted mortality rate was seen for BHS4, which was a randomized controlled trial and enrolled a healthier patient population. Although mortality at 12 months was lower for both sexes in BHS7, compared to BHS2, there were no significant differences in mortality across studies. Although not statistically significant, findings from this study are consistent with other reports of declining mortality in the general population and hip fracture patients.^{12,13,15,32}

During the analysis period, residential options for older adults drastically increased, with substantial growth between 1993 and 2007 in the number of assisted living facilities per the number of older adults.³³ Between BHS2 and BHS7, men saw a non-significant 5.3% decline in 12-month nursing home placement while women saw a significant 17.0% decline. One study found that 12-month nursing home residency remained stable among Medicare beneficiaries with hip fractures between 2000 and 2008.¹² Although this is consistent with our findings in men, it is contrary to our findings in women.

Over the time period studied, older men undergoing usual care post-fracture had no significant improvements in 12-month outcomes after fracture. Women experienced significant improvements in outcomes from BHS2 (enrollment 1990–1991) to BHS3 (enrollment 1992–1995) with no subsequent improvements in later studies. The BHS had varying recruitment strategies, study designs, and study samples. To account for these differences, careful case-mix adjustments were made in the analyses; residual disability remained across all studies even after adjustment for these case-mix differences. This

adjustment allowed us to isolate the impact of other factors such as surgical treatment, in-hospital care, rehabilitation, and policies versus shifts in patient characteristics, on outcomes.

With respect to surgical care, internal fixation is becoming less common and nonoperative treatment is on the decline.¹⁴ Surgical procedure did not significantly differ across studies, suggesting that shifts in surgical type did not substantially impact patient outcomes. The lack of improvement in patient disability over time is consistent with recent reviews concluding that although the current state of rehabilitation for hip fracture patients is beneficial, usual rehabilitation practices are still not fully returning patients to their pre-fracture level of function.^{10,34} Rehabilitation, in general, aims to improve mobility and independence in patients and can include strength training, mobility training (potentially with assistive devices), and pain management.³⁴ However, “usual care” for hip fracture patients at all phases of rehabilitation (acute, post-acute setting, community) is not standardized and often based on provider experience and local protocols.³⁴ Rehabilitation intervention studies also provide insufficient detail on the care that control groups received, making the assessment of outcomes across studies difficult.²⁰ Despite many years of extensive research on hip fracture outcomes, the most effective interventions to improve mobilization, physical function, and psychosocial function after hip fracture remain elusive.^{35,36} Australia³⁷ and the United Kingdom³⁸ have published recommendations for rehabilitation in hip fracture patients, although no such guidelines have been published in the United States.³⁹ The majority of research on hip fracture outcomes, treatment, and rehabilitation focuses on women¹¹. The improvements seen in women between BHS2 and BHS3 could be the result of women disproportionately benefitting from this sex-specific research. Lastly, the overall findings of this study may reflect the lack of consideration of psychosocial factors, such as depression⁴⁰ and resilience⁴¹ that influence recovery following hip fracture.

Study Limitations

The lack of improvement in residual disability for men and small improvements in women over the 20 years represented by these studies could also be explained by selection bias, specifically survivorship. For example, if mortality improved over time, sicker patients that would have previously died after a hip fracture are now surviving and inflating residual disability. However, no significant improvement in survival was seen in this study and the composite outcome results accounting for mortality suggest a similar pattern to the residual disability outcome alone.

The trends in residual disability, mortality, and nursing home placement in this study may not be generalizable to the larger hip fracture population given that these studies were conducted in community-dwelling, older adults meeting restricted entry criteria from a limited geographic area. Still, differences observed across the BHS cohorts match changes in some outcomes observed nationally. Differences across studies were present for MMSE scores, education, length of stay, and discharge location. Nationally, MMSE scores and education levels have improved over time.⁴² Changes in Medicare reimbursement policy, such as the Balanced Budget Act¹⁹, have shifted rehabilitative care from the hospital to

skilled nursing facilities (SNFs) and other settings, which is also reflected in the present analysis where lengths of hospital stay decreased and use of subacute care in SNFs increased over 20 years.

There are some additional limitations of this study. We were unable to examine changes in other patient outcome measures over time as we were restricted to those measures captured across the studies. We may have missed additional improvements in the LPADL beyond 12 months as only one study included a two-year follow-up (BHS2).⁶ However, BHS2 found that maximal recovery in lower extremity ADLs was reached at 11.2 months.⁶ Despite adjustment for case-mix, residual confounding may remain given that models were only adjusted for baseline differences in studies and for baseline characteristics collected across all studies. Although residual confounding cannot be ruled out, key factors known to be associated with recovery outcomes, such as age, comorbid disease, and cognitive status, were adjusted for in models of 12-month residual disability and composite outcomes.⁷ Outcomes may also differ by where rehabilitation takes place.^{34,43–45} The use of proxies in the cohort studies may also be problematic. Proxies systematically rate greater disability than patients self-report in hip fracture patients.⁴⁶ Lastly, limited data were available in BHS cohorts on outcomes among men.

CONCLUSIONS

As Medicare data does not have functional outcomes, the BHS provides a unique opportunity to compare over 20 years of data on patients from a similar source population. In summary, we have not yet resolved the problem of residual disability following hip fracture. From 1991 to 2011, men receiving usual care for hip fracture have seen no improvements in outcomes and women have seen initial, early improvements with no subsequent improvements. The vast majority of hip fracture patients face new disabilities, despite rehabilitative care. Further, contemporary studies are needed to understand how treatment and rehabilitation can be improved or better implemented across the continuum of post-hip fracture care to minimize long-term disability among this patient population.⁴⁷ Future studies will need to operationalize usual care into multidisciplinary, multimodal interventions that can be tested in carefully controlled efficacy studies and in pragmatic clinical trials.

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ABBREVIATIONS:

3MS	Modified Mini-Mental State
BHS	Baltimore Hip Studies

BMI	Body Mass Index
LPADL	Lower Extremity Physical Activities of Daily Living
MMSE	Mini-Mental State Examination
SNFs	Skilled Nursing Facilities

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Figure 1. Adjusted* 12-month residual disability with 95% confidence intervals stratified by study and sex

Figure 2. Adjusted* proportion of hip fracture patients with 12-month residual disability or death with 95% confidence intervals stratified by study and sex

Figure 3. Adjusted* proportion of hip fracture patients with 12-month residual disability or death or nursing home residency with 95% confidence intervals stratified by study and sex

Table 1.

Description of design, enrollment, eligibility, study sample, follow-up, and objectives of Baltimore Hip Studies (BHS) included in overall analysis.

Study	Design	Enrollment Period	Entry Criteria	Sample Composition	Follow-Up from Time of Fracture	Objective
BHS ²⁶	Prospective Cohort	1990–1991	Community-dwelling, 65 years of age	152 Men 522 Women	2, 6, 12, 18, 24 months	To identify factors that impact hip fracture survival and recovery
BHS ³²¹	Prospective Cohort	1992–1995	White, community-dwelling	205 Women	2, 6, 12 months	To examine changes in muscle and bone after hip fracture
BHS ⁴²⁴	Randomized Controlled Trial	1998–2004	Community-dwelling, 65 years of age, cognitively intact, able to walk independently prior to fracture, no contraindications to exercise, cleared by orthopedic surgeon	180 Women	2, 6, 12 months	To determine the impact of exercise on bone metabolism post-fracture
BHS ⁵²⁵	Randomized Controlled Trial	2000–2004	Community-dwelling, 65 years of age, cognitively intact, able to walk independently prior to fracture, no contraindications to exercise	208 Women	2, 6, 12 months	To determine the effectiveness of exercise and motivation and exercise behavior and recovery after hip fracture
BHS ⁷²³	Prospective Cohort	2006–2011	Community-dwelling, 65 years of age, cognitively intact, ambulatory in six months prior to fracture	168 Men 171 Women	2, 6, 12 months	To compare hip fracture recovery between men and women

Table 2.

Baltimore Hip Study (BHS) Patient Characteristics Stratified by Study and Sex

Characteristic	BHS2		BHS3		BHS4		BHS5		BHS7		ANOVA or Chi-Square P-Value	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
	n=121	n=365	n=150	n=76	n=44	n=119	n=114					
Characteristic												
Age (yrs) *, m (sd)	79.1 (7.5)	81.5 (7.3)	76.7 (11.6)	81.8 (6.3)	79.2 (6.5)	81.1 (7.7)	81.9 (7.8)				0.05	<0.01
Race, n (%)											0.35	0.01
White	110 (90.9)	341 (93.4)	150 (100.0)	75 (98.7)	43 (97.7)	112 (94.1)	107 (93.9)					
Non-white	11 (9.1)	24 (6.6)	0 (0)	1 (1.3)	1 (2.3)	7 (5.9)	7 (6.1)					
Marital Status, n (%)											0.37	0.03
Married	67 (55.4)	75 (20.5)	33 (22.0)	26 (34.2)	14 (31.8)	59 (49.6)	34 (29.8)					
Not Currently Married	54 (44.6)	290 (79.5)	116 (77.3)	50 (65.8)	30 (68.2)	60 (50.4)	80 (70.2)					
Unknown	0 (0)	0 (0)	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0.0)					
Education, n (%)											<0.01	<0.01
< High School	45 (37.2)	140 (38.4)	42 (28.0)	20 (26.3)	14 (31.8)	32 (26.9)	18 (15.8)					
High School	63 (52.1)	178 (48.8)	106 (70.7)	54 (71.1)	30 (68.2)	86 (72.3)	96 (84.2)					
Unknown	13 (10.7)	47 (12.9)	2 (1.3)	2 (2.6)	0 (0.0)	1 (0.8)	0 (0.0)					
Comorbidity Count, m (sd)	2.5 (1.5)	2.1 (1.4)	2.3 (1.6)	2.4 (1.5)	3.0 (1.5)	3.1 (1.6)	2.6 (1.5)				0.01	<0.01
MMSE (score range 0 to 36, high=good), m (sd)	21.3 (6.3)	22.4 (5.4)	23.1 (4.4)	27.0 (2.4)	26.9 (2.7)	23.0 (4.5)	24.4 (4.2)				0.03	<0.01
BMI (kg/m ²), m (sd)	23.2 (4.1)	22.2 (4.3)	22.6 (4.7)	24.4 (4.6)	23.5 (4.3)	25.8 (4.4)	25.2 (6.2)				<0.01	<0.01
Type of Fracture, n (%)											0.09	0.09
Intertrochan teric	66 (54.5)	200 (54.8)	71 (47.3)	34 (44.7)	22 (50.0)	52 (43.7)	47 (41.2)					
Other	55 (45.5)	165 (45.2)	79 (52.7)	42 (55.3)	22 (50.0)	66 (55.5)	67 (58.8)					
Missing						1 (0.8)						
Type of Surgery, n (%)											0.19	0.06
Internal Fixation	79 (65.3)	239 (65.5)	87 (58.0)	43 (56.6)	24 (54.5)	67 (56.3)	60 (52.6)					
Other	41 (33.9)	121 (33.2)	59 (39.3)	33 (43.4)	20 (45.5)	52 (43.7)	54 (47.4)					
Unknown	1 (0.8)	5 (1.4)	4 (2.7)	0 (0)	0 (0)	0 (0.0)	0 (0.0)					

	BHS2		BHS3	BHS4	BHS5	BHS7		ANOVA or Chi-Square P-Value	
	Men	Women	Women	Women	Women	Men	Women	Men	Women
	n=121	n=365	n=150	n=76	n=44	n=119	n=114		
Length of Stay (days), m (sd)	16.6 (10.3)	13.9 (7.5)	8.6 (4.7)	4.1 (1.2)	4.6 (1.5)	5.5 (2.5)	5.2 (3.1)	<0.01	<0.01
Discharge Location, n (%)								<0.01	<0.01
Home	46 (38.0)	98 (26.8)	29 (19.3)	2 (2.6)	1 (2.3)	5 (4.2)	5 (4.4)		
Facility	69 (57.0)	253 (69.3)	120 (80.0)	74 (97.4)	42 (95.5)	114 (95.8)	109 (95.6)		
Unknown	6 (5.0)	14 (3.8)	1 (0.7)	0 (0)	1 (2.3)	0 (0)	0 (0.0)		
Baseline LPADL, m (sd)	4.0 (3.8)	3.4 (3.6)	4.8 (3.4)	2.1 (2.3)	1.5 (2.5)	2.4 (2.4)	2.7 (2.4)	<0.01	<0.01

m, mean; sd, standard deviation

* Deidentified datasets were used for BHS4 and BHS5 analysis whereby all women 90 or older had their age assigned to 90. In our study sample, this impacted ten subjects in BHS4 and two subjects in BHS5.

Table 3.

Baltimore Hip Study (BHS) patient single and composite unadjusted outcomes stratified by study and sex

Hip Study	Sex	Baseline n	Residual Disability Mean	Residual Disability * %	Dead at 12 Months %	Nursing Home Residency at 12 months %	Residual Disability * or Dead (Composite Outcome 1) %	Residual Disability * or Dead or Nursing Home Residency at 12 months (Composite Outcome 2) %
BHS2	W	365	3.8	88.1	15.9	24.9	90.2	92.3
BHS2	M	121	3.5	85.5	38.0	16.0	91.3	91.7
BHS3	W	150	2.7	74.4	15.3	11.0	78.4	79.3
BHS4	W	76	2.2	72.2	5.3	1.4	73.7	73.7
BHS5	W	44	3.0	78.1	6.8	0.0	79.6	79.6
BHS7	W	113	2.4	75.0	11.4	7.9	77.9	79.8
BHS7	M	119	3.2	86.8	29.4	10.7	90.7	90.8

M, men; W, women

* Residual disability is defined here as having a value of greater than zero when baseline Lower Extremity Physical Activities of Daily Living (LPADL) score is subtracted from the 12 month LPADL score