Does Functional Recovery in Elderly Hip Fracture Patients Differ Between Patients Admitted From Long-Term Care and the Community?

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Background. It is largely unknown whether functional recovery following hip fracture differs between long-term care (LTC) and community-dwelling residents. Our primary purpose was to compare recovery between these patients 6 months following hip fracture, controlling for known prognostic factors. Secondly, we examined the contribution of residential status, in addition to patient characteristics, to functional recovery.

Methods. We studied a population-based inception cohort of 451 hip fracture patients ≥ 65 years old admitted to one Canadian health region hospital between July 1999 and September 2000. Participants completed the Modified Barthel Functional Index (MBI) in hospital and again via telephone interviews 6 months postoperatively. Data were also collected on surgery and rehabilitation timing, length of hospital stay (LOS), and discharge destination. Relative change from prefracture function adjusting for known prognostic factors, and the proportion of participants returning to prefracture function were compared between the LTC and community-dwelling residents.

Results. LTC residents (n = 115) were older, with lower function prefracture, more comorbidities, and increased dementia than community-dwelling residents (n = 336). Six months postfracture, 17 (22%) LTC and 180 (71%) community-dwelling residents had regained prefracture function (p < .001). LTC residents had 33% lower (−40.6, −27.2) and community-dwelling residents 11.6% lower (−14.8, −8.4) 6-month MBI scores relative to prefracture scores after risk adjustment. Residential status was significantly associated with risk-adjusted functional recovery (p < .001). Median LOS was 4 days less for LTC than for community-dwelling residents (p < .001). Twelve (10%) LTC and 266 (79%) community-dwelling residents were discharged to inpatient rehabilitation (p < .001).

Conclusion. Following hip fracture, most LTC residents do not regain prefracture function irrespective of known prognostic factors. Further investigation is needed as to the extent to which personal and environmental characteristics contribute to outcome after hip fracture.

HIP fractures are common events associated with significant morbidity and mortality in older age groups (1). Seniors residing in long-term care (LTC) are at higher risk of hip fracture than are community-dwelling seniors (2–5). Despite increased fracture risk, many studies specifically exclude LTC residents (6–11). Mortality has been well documented in these frail patients; however, evidence is sparse regarding the impact of hip fracture on subsequent function (4,12–14).

Hip fracture frequently leads to decreased function, even in community-dwelling persons (8,10). Recovery appears dependent on several factors including prefracture function, age, and cognition (15–17). Typically, seniors residing in LTC are older with lower cognitive and functional status than their community-dwelling counterparts (12,13). These characteristics place LTC residents at higher risk for poor outcomes following hip fracture.

This evaluation is part of a larger study that examined the effect of standardized clinical pathway implementation on functional recovery in elderly hip fracture patients (18). The current analysis examines only those patients who received standardized pathway treatment.

The primary objective of this analysis was to determine if LTC residents who survived their hip fracture had lower functional return than community-dwelling residents after accounting for prefracture differences and known prognostic factors. Secondarily, we determined the association of prognostic factors and prefracture residence with the adjusted 6-month outcome. Finally, we compared health services delivery in the surgical hospital as a potential determinant of outcome.

Methods

Design

This study used a population-based inception cohort from two hospitals in one tertiary health region. All hip fracture patients in the region are admitted to one of these two sites. Data were collected from a consecutive cohort of patients treated between July 1999 and September 2000. The Research Ethics Board gave ethics approval.

Participants

All patients older than 64 years admitted with a hip fracture (International Classification of Disease [ICD] Ninth Revision categories 820.0–820.9) living within local calling distance were eligible for study enrollment. Enrollees were...
classified as community-dwelling (community or retirement home) or LTC-dwelling based on admission status; those participants admitted from community or retirement home settings, but discharged to LTC settings, were analyzed in the community-dwelling group. LTC settings were defined as long-term residential settings with nursing care required for basic daily activities. In retirement home settings, individuals did not require nursing care, but may have received assistance with some activities (e.g., bathing).

Persons excluded were patients with a pathological fracture (e.g., tumor, Paget’s) or recurrent hip fracture, those who were already enrolled, proxy or patient respondents who were unable to communicate in English, or those who were without telephone access.

Eligible participants were identified through examination of admission records. Proxy respondents, typically immediate family members, were identified to participate on behalf of persons who were unable to respond on their own. The Mini-Mental State Examination (MMSE) was used to ascertain cognitive impairment; scores < 22/30 indicated cognitive impairment. Patient or proxy respondents were approached on average 5.4 days postoperatively by a research health professional, and written informed consent was obtained for study enrollment.

At the initial interview, participants rated function immediately prior to the fracture using the Modified Barthel Functional Index (MBI) (19–21). We also collected information about participants’ prefracture personal and/or telephone social contact. Follow-up telephone interviews, using the MBI, were undertaken with participants 3 and 6 months postfracture. Data were obtained from medical record review on (i) comorbid conditions, (ii) time to surgery, (iii) time to initial postoperative physical therapy visit, (iv) length of stay (LOS) in the surgical hospital, and (v) discharge destination.

**Standardized Measures**

**Modified Barthel Index.**—The primary outcome measure was the MBI, which measures dependence in 10 activities: feeding, personal hygiene, bathing, dressing, toilet transfers, bowel control, bladder control, chair and/or bed transfers, walking, and stair-climbing. The MBI uses a three-point Likert Scale, “unable to perform task” (0 points), “needs assistance” (5 or 10 points), “fully independent” (10 or 15 points), with total scores ranging from 0–100.

This index, frequently used in geriatric populations (20,21), takes approximately 5–10 minutes to complete, and has been validated for telephone and proxy respondent report (19). Acceptable concordance between patient and proxy respondents has been reported on performance-based measures, particularly when the proxy is a family member (22,23). In this study, > 90% of proxy respondents were family members. The same respondents were used throughout the study for 86% of participants with no group differences. Over 80% of LTC participants required proxy respondents compared to < 20% of community-dwelling participants.

**Mini-Mental State Examination.**—The MMSE examines cognitive status through an 11-item questionnaire that takes approximately 5 minutes to complete (24,25). The cutoff score for detecting probable cognitive impairment is < 22; this score best balances sensitivity (0.87) and specificity (0.82) for clinical applications (26,27).

**Charlson Comorbidity Index.**—The Charlson comorbidity index, a weighted index of mortality risk that considers both number and severity of comorbidities (28), has been reported to reliably predict mortality in elderly LTC residents (29).

**Evaluation of acute care hospital services.**—This evaluation was performed through medical records review. We examined surgical and rehabilitation timing, postoperative weightbearing status, hospital LOS, and discharge destination.

**Data Analysis**

Baseline characteristics (e.g., age, comorbidities) were compared using standard statistical techniques (independent t tests for continuous and chi-square tests for categorical variables) to identify any initial differences between community-dwelling and LTC residents. Study participation and losses to follow-up were examined for systematic variation.

Functional recovery was analyzed comparing the proportion of each group who returned to prefracture function by 6 months postfracture. Specific categories on the MBI were examined to determine where loss in functional independence occurred, if present.

We performed analysis of covariance (ANCOVA), controlling for comorbid conditions, age, gender, cognitive status, social support, marital status, and prefracture function. These variables were chosen as they were previously reported to impact outcome following hip fracture.

LTC residents were expected to have lower absolute MBI scores at all evaluations; thus we chose to measure change in scores to offset the known baseline differences in function between groups. We examined two accepted methods of controlling for baseline differences—one using absolute change in MBI score (prefracture score minus the 6-month score) and the second using relative change in MBI score (6-month score minus the prefracture score; that value divided by prefracture MBI score and the new value multiplied by 100). Relative change was was chosen for the analysis because it was less impacted by baseline scores (30). To our knowledge, no published value of minimal relative change for the MBI score has been reported in the literature.

In addition to ANCOVA, we examined the association of each covariate, as well as that of prefracture residential status, with 6-month outcomes using multiple linear regression. We also used the regression procedure in SPSS (Statistical Package for the Social Sciences; SPSS Inc., Chicago, IL) to test the goodness-of-fit of the final ANCOVA model using residual analysis.

We planned a subgroup analysis to investigate the impact of fracture on patients who were ambulatory prefracture. Participants were classified as ambulatory if they walked independently with or without mechanical aids; those who did not walk or who required personal assistance to ambulate were considered nonambulatory. The ANCOVA
model was performed on this subset to determine if ambulatory LTC residents had a better functional outcome than the nonambulatory LTC population.

Acute care hospital services were analyzed using parametric tests (e.g., t tests) if data were normally distributed and nonparametric tests (e.g., Mann–Whitney U or chi-square tests) if data were skewed. Comparisons were made regarding (i) time to surgical fixation, (ii) time to initial postoperative rehabilitation, (iii) postoperative weight-bearing status, (iv) LOS in the surgical hospital, and (v) discharge destination. Service delivery comparisons were undertaken to determine if the two groups received differential care during the initial postoperative phase.

All analyses were undertaken using SPSS version 14.0. Participants were classified as either LTC or community-dwelling residents based on admission residence rather than discharge residence. All tests were two-tailed with the level of significance set at α = 0.05.

RESULTS

Demographics

Six hundred sixty-three individuals were eligible for inclusion. Of these, 40 (6%) patients died in hospital. Of the remaining participants, 115 of 181 (64%) LTC residents and 336 of 442 (76%) community-dwelling residents agreed to participate (Figure 1).

Nonparticipants were similar to participants, with the following exception: community-dwelling nonparticipants...
were more likely to experience multiple complications than were participants (p = .004), although only small numbers in either group experienced multiple complications. Participants residing in LTC settings were more likely to be older, have more comorbidities and dementia, and be single or widowed than community residents (Table 1). LTC residents also had lower function and less social contact prefracture than community residents (Table 1). LTC participants surviving to the succeeding assessment. As shown in Figure 1, a greater proportion of LTC than community-dwelling patients and 11 days (minimum 4, maximum 67) for LTC patients were discharged to inpatient rehabilitation, bearing as tolerated postoperatively (p = .56 for group differences). Eighty-seven (78%) LTC and 269 (82%) community-dwelling patients were weight-bearing as tolerated postoperatively (p = .62). The median LOS was 7 days (minimum 4, maximum 68) for LTC patients and 11 days (minimum 4, maximum 67) for community-dwelling patients (p < .001). Only 12 (10%) LTC patients were discharged to inpatient rehabilitation, with the remaining participants returning to their residential setting. In contrast, 266 (79%) community-dwelling patients were discharged to inpatient rehabilitation (p < .001).

**Functional Recovery**

Six months following fracture, 180 (71%) community-dwelling residents had returned to prefracture function, compared to only 17 (22%) LTC residents. In general, loss of independence occurred in all MBI categories for the LTC group, particularly in ambulation and transfer activities; this pattern was not repeated in the community-dwelling group (Table 2).

**Risk-Adjusted Relative Change in MBI Score**

After adjusting for age, gender, marital status, social support, prefracture function, comorbidity index score, and cognition, LTC residential status was associated with significantly lower relative functional return on the MBI. A goodness-of-fit test for the ANCOVA model detected two extreme outliers in the LTC group. Both participants had very low baseline MBI scores (≤5 points). Although they had large positive relative changes, their overall MBI score remained very low (≤25). The adjusted R² improved to 0.35 from 0.19 with these two outliers removed; thus, their data were not included in the ANCOVA analysis reported in Table 3.

On average, LTC residents had a predicted relative MBI score that was 33.9% lower (95% confidence interval [CI], −40.6% to −27.2%) 6 months after fracture relative to their prefracture score, compared to 11.6% lower (95% CI, −14.8% to −8.4%) in community-dwelling patients after risk adjustment (p < .001). LTC residential status was strongly associated with lower functional recovery (p < .001) (Table 3). Restricting these analyses to patients who were ambulating prior to their hip fracture did not change the findings on the ANCOVA models (data not shown).

**Acute Care Hospital Services**

On average, all patients underwent surgery within 1 day of admission (p = .54 for group differences) and started active rehabilitation on the second postoperative day (p = .56 for group differences). Eighty-seven (78%) LTC and 269 (82%) community-dwelling patients were weight-bearing as tolerated postoperatively (p = .62). The median LOS was 7 days (minimum 4, maximum 68) for LTC patients and 11 days (minimum 4, maximum 67) for community-dwelling patients (p < .001). Only 12 (10%) LTC patients were discharged to inpatient rehabilitation, with the remaining participants returning to their residential setting. In contrast, 266 (79%) community-dwelling patients were discharged to inpatient rehabilitation (p < .001).

**DISCUSSION**

The findings from this population-based inception cohort indicate that LTC residents were at much higher risk of not

### Table 1. Baseline Demographics for LTC and Community-Dwelling Residents

<table>
<thead>
<tr>
<th>Variable</th>
<th>LTC (N = 115)</th>
<th>Community Dwelling (N = 336)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD), y</td>
<td>85.0 (7.3)</td>
<td>80.7 (7.7)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
<td>.44</td>
</tr>
<tr>
<td>Female</td>
<td>93 (81)</td>
<td>259 (77)</td>
<td></td>
</tr>
<tr>
<td>Married (%)</td>
<td>33 (29)</td>
<td>253 (76)</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>Charlson Comorbidity Index (%)</td>
<td></td>
<td></td>
<td>&lt;.001‡</td>
</tr>
<tr>
<td>None</td>
<td>3 (2)</td>
<td>98 (29)</td>
<td></td>
</tr>
<tr>
<td>Mild (1–2 conditions)</td>
<td>70 (61)</td>
<td>156 (46)</td>
<td></td>
</tr>
<tr>
<td>Moderate (3–4 conditions)</td>
<td>32 (28)</td>
<td>69 (21)</td>
<td></td>
</tr>
<tr>
<td>Severe (≥5 conditions)</td>
<td>10 (9)</td>
<td>13 (4)</td>
<td></td>
</tr>
<tr>
<td>Known dementia on admission</td>
<td>87 (77)</td>
<td>48 (14)</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>Mean baseline MBI (SD)</td>
<td>64.1 (24.6)</td>
<td>92.4 (12.6)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Fracture type (%)</td>
<td></td>
<td></td>
<td>.74†</td>
</tr>
<tr>
<td>Femoral neck</td>
<td>57 (50)</td>
<td>180 (54)</td>
<td></td>
</tr>
<tr>
<td>Trochanteric</td>
<td>58 (50)</td>
<td>156 (46)</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** †Two-sample independent t test, LTC = long-term care; SD = standard deviation; MBI = Modified Barthel Index.

 Chi-square test with 1 degree of freedom.

 Chi-square test with 3 degrees of freedom.

### Table 2. Number and Proportion of Patients Independent in Categories of the Modified Barthel Index in LTC and Community-Dwelling Residents Comparing Prefracture Status to 6-Month Postfracture Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>LTC Prefracture</th>
<th>LTC Postfracture</th>
<th>Community Prefracture</th>
<th>Community Postfracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking*</td>
<td>91 (79)</td>
<td>34 (45)</td>
<td>326 (97)</td>
<td>228 (89)</td>
</tr>
<tr>
<td>Walking†</td>
<td>45 (39)</td>
<td>3 (4)</td>
<td>204 (61)</td>
<td>67 (26)</td>
</tr>
<tr>
<td>Chair transfers</td>
<td>93 (80)</td>
<td>36 (47)</td>
<td>326 (97)</td>
<td>235 (92)</td>
</tr>
<tr>
<td>Toilet transfer</td>
<td>50 (44)</td>
<td>11 (15)</td>
<td>321 (96)</td>
<td>224 (88)</td>
</tr>
<tr>
<td>Stair climbing</td>
<td>64 (56)</td>
<td>11 (15)</td>
<td>308 (92)</td>
<td>202 (77)</td>
</tr>
<tr>
<td>Hygiene</td>
<td>59 (51)</td>
<td>17 (22)</td>
<td>317 (94)</td>
<td>205 (90)</td>
</tr>
<tr>
<td>Dressing</td>
<td>40 (35)</td>
<td>7 (9)</td>
<td>294 (88)</td>
<td>185 (73)</td>
</tr>
<tr>
<td>Bathing</td>
<td>10 (9)</td>
<td>1 (1)</td>
<td>239 (71)</td>
<td>109 (48)</td>
</tr>
<tr>
<td>Feeding</td>
<td>68 (59)</td>
<td>33 (43)</td>
<td>315 (94)</td>
<td>227 (89)</td>
</tr>
<tr>
<td>Bowel</td>
<td>60 (52)</td>
<td>19 (25)</td>
<td>296 (88)</td>
<td>216 (85)</td>
</tr>
<tr>
<td>Bladder</td>
<td>41 (36)</td>
<td>11 (15)</td>
<td>248 (74)</td>
<td>192 (75)</td>
</tr>
</tbody>
</table>

**Notes:** *With/without assistive devices. LTC = long-term care.

†Without any assistive devices. **Note:** This is not part of the Modified Barthel Index, which denotes independence in walking regardless of whether or not assistive devices are used.
returning to prefracture functional levels following hip fracture even after controlling for age, baseline function, comorbidities, and cognitive status. Relative loss in function from prefracture levels was significantly greater in LTC than in similar community-dwelling residents. We used change in function relative to the baseline score rather than the difference between baseline and 3-month scores in function, as it was anticipated that LTC residents would have lower prefracture function than would community-dwelling residents. To our knowledge, little research has examined recovery following hip fracture in this fragile LTC population (12–14), but rather has focused on mortality (31,32). As many environmental difference between community-dwelling and LTC residents was rehabilitation access. Most LTC residents returned to their prefracture setting within 1 week of fracture, whereas most community-dwelling residents had, on average, four more days of rehabilitation in the surgical hospital and a further stay in a rehabilitation hospital. Others have reported that LTC residents are less likely to receive rehabilitation than community-dwelling residents (12,14). LTC residents are not eligible for admission to defined rehabilitation institutions within our health region because of inadequate rehabilitation resources. As LTC patients have an institutional bed prior to hospital admission, patients are returned to their residential facility when they are deemed medically stable. Because of this approach, these patients do not receive as much in-hospital rehabilitation as do patients from the community.

Although dementia, which is adversely related to functional recovery (12,34,35,37), is highly prevalent in elderly persons living in LTC, it is not a contraindication for rehabilitation (12,38,39). More importantly, we found that dementia and admission residence were not collinear in the adjusted models; this finding suggests that we are not measuring the same construct. Participants with cognitive impairment who were mobile prior to hip fracture have been able to return to similar function postfracture following rehabilitation (35,38). Following return to their residential setting, the type and amount of rehabilitative services received in LTC are unknown. We only measured recovery and cannot assert that rehabilitation interventions would further improve function. These individuals are in frail health prefracture, and the injury may be of such significant magnitude as to lead to poor functional recovery, regardless of postoperative care and rehabilitation. However, as most patients were ambulatory prefracture, it was unclear whether

### Table 3. Unadjusted and Adjusted Linear Regression of Relative Change in MBI From Baseline to 6 Months After Hip Fracture

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unadjusted</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>95% CI</td>
</tr>
<tr>
<td>Age</td>
<td>−1.1</td>
<td>−1.6, −0.73</td>
</tr>
<tr>
<td>Female</td>
<td>1.8</td>
<td>−6.6, 10.3</td>
</tr>
<tr>
<td>LTC admission</td>
<td>−34.2</td>
<td>−41.2, −27.3</td>
</tr>
<tr>
<td>MMSE &lt; 22</td>
<td>−29.7</td>
<td>−35.6, −23.7</td>
</tr>
<tr>
<td>Charlson Score</td>
<td>1.0</td>
<td>Reference</td>
</tr>
<tr>
<td>No social support</td>
<td>−21.9</td>
<td>−29.3, −14.4</td>
</tr>
<tr>
<td>Not married</td>
<td>−6.1</td>
<td>−13.1, 0.8</td>
</tr>
</tbody>
</table>

**Notes:** R² = 0.36.

MBI = Modified Barthel Index; CI = confidence interval; LTC = long-term care; MMSE = Mini-Mental State Examination.

*Results from simple regression analysis (one independent variable in each regression) with two participants’ data removed.

1Results from multiple regression analysis with two participants’ data removed.

2Unstandardized regression coefficient.

3Standardized regression coefficients are given for comparison of relative importance of each variable.

4Significant at p < .05.

5Significant at p < .001.
their functional loss was related to an inability to respond to, or lack of access to, rehabilitation.

Because dementia was more prevalent in the LTC residents, more proxy respondents were used in this group. We made every attempt to reduce potential biases. Respondents rated observable, performance-based activities on the MBI; thus, scores are more likely to agree between patient and proxy respondents (22,23,40). Furthermore, >90% of proxy respondents were family members, and for the most part, the same respondent was used throughout the study. Finally, as we recorded change in function, systematic differences between respondent types should have been further minimized. Although a component of group differences may be related to the respondent used, the difference appears too large to attribute solely to respondent used.

We performed a prospective population-based cohort study, specifically including persons from all settings, so that we could assess return to prefracture function following hip fracture, even in the frailest patient subgroup. The nine LTC patients lost to follow-up had better baseline function than did the patients completing the study, which may have led to an overestimation of the functional loss in the LTC group; however, the losses to follow-up represent only a small proportion of the LTC group.

To our knowledge, this study is one of few studies examining risk-adjusted functional recovery, rather than mortality, specifically in LTC residents. Because this study includes all willing participants within the entire health region who met inclusion criteria, our results are generalizable to the entire population in this urban area and to other areas where patients and care strategies are similar to those in the present study.

Summary

Long-term care residents experienced poor functional recovery after hip fracture irrespective of known prognostic factors such as age, comorbidities, and dementia. These findings are pertinent given aging trends and increasing hip fracture incidence. Moreover, it is alarming that such a high proportion of persons residing in LTC became nonambulatory after hip fracture despite being independent ambulators prior to fracture. Prefracture admission status appeared to be an important contributor to the adjusted functional model, which would suggest that further investigation is warranted to determine if the functional loss seen in LTC residents was related to facility-based characteristics or whether it was due to a multiplicity of patient characteristics commonly seen in LTC residents that were not measured in our study. In light of these findings, further research should determine if further medical and/or rehabilitation interventions will allow LTC residents to regain prefracture function following hip fracture.

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