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Original Study

Effects of Dementia on Postoperative Outcomes of Older Adults With Hip Fractures: A Population-Based Study

Dallas P. Seitz MD [a,*], Sudeep S. Gill MD, MSc [b,c], Andrea Gruneir PhD [d,e,f], Peter C. Austin PhD [e,f], Geoffrey M. Anderson MD, PhD [e,f], Chaim M. Bell MD, PhD [e,f,g], Paula A. Rochon MD, MPH [d,e,f]

[a] *Department of Psychiatry, Queen's University, Kingston, Ontario, Canada*
[b] *Department of Medicine, Queen's University, Kingston, Ontario, Canada*
[c] *Institute for Clinical Evaluative Sciences, Queen's University, Kingston, Ontario, Canada*
[d] *Women's College Research Institute, Women's College Hospital, Toronto, Ontario, Canada*
[e] *Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada*
[f] *Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada*
[g] *Department of Medicine, Mt. Sinai Hospital, Toronto, Ontario, Canada*

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A B S T R A C T

Objective: To evaluate the association between dementia and postoperative outcomes of older adults with hip fractures.
Design: Population-based, retrospective cohort study.
Setting: Province of Ontario, Canada.
Participants: All individuals with hip fractures who underwent hip fracture surgery in Ontario, Canada between April 1, 2003 and March 31, 2010 were identified. Physician-diagnosed dementia, prior to hip fracture, was identified using a diagnostic algorithm in the administrative databases.
Measurements: The preoperative characteristics of older adults with and without dementia were compared separately for individuals admitted to hospital from community or long-term care (LTC). Multivariable regression was used to compare postoperative health service utilization, time with LTC admission, and mortality for individuals with and without dementia.
Results: A total of 45,602 older adults had hip fractures and individuals with dementia accounted for 23.9% and 83.5% of all hip fractures from the community and LTC settings, respectively. Compared with those without dementia, individuals with dementia were less likely to be admitted to rehabilitation facilities. Among community-dwelling older adults, dementia was associated with an increased risk of LTC admission [hazard ratio (HR) = 2.49, 95% confidence interval (CI): 2.38–2.61, $P < .0001$]. Dementia was also associated with a higher mortality for older adults from community (HR = 1.47, 95% CI: 1.41–1.52, $P < .0001$) and LTC (HR = 1.10; 95% CI: 1.02–1.18, $P = .005$) settings.
Conclusions: Dementia is common among older adults with hip fractures and associated with poor prognosis following hip fracture surgery. Specialized services targeting the growing number of older adults with dementia may help to prevent hip fractures and optimize postoperative care for this vulnerable population.

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All authors have contributed to the conception and design of the study, provided revisions to the manuscript and all authors approve of the final submitted manuscript. The authors of the manuscript have no financial conflicts of interest to disclose. DPS 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.

* Address correspondence to Dallas P. Seitz, MD, Providence Care Mental Health Services, 752 King Street West, Kingston, Ontario, Canada K7L 4X3.
E-mail address: seitzd@providencecare.ca (D.P. Seitz).

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The prevalence of dementia is increasing in most developed countries,[1,2] and there is a growing need for services to support this population. Given the advanced age at which most individuals develop dementia,[3] older adults with dementia have 4 chronic medical conditions[4] and are prescribed between 5 and 12 medications[5,6] highlighting their medical complexity. When compared with other populations of older adults, those with dementia have higher rates of outpatient visits to family physicians,[4,7] greater number of emergency room (ER) visits,[4,8] higher rates of hospitalization,[4,7,8] and more prolonged hospital stays.[8,9] Following hospitalization, older adults with dementia are also at risk for poor outcomes including increased rates of functional decline,[10] higher rates of admission to long-term care (LTC) facilities[11] and increased mortality.[12]

Hip fractures are a common acute health condition among older adults and may be particularly challenging to manage among individuals with dementia. Approximately 19% of all older adults with hip fractures have dementia, and up to 40% of individuals with hip fractures having some degree of cognitive impairment that may not meet criteria for dementia.[13] Individuals with dementia are at increased risk for hip fractures[14] due to their high risk of falls,[15,16] high prevalence of osteoporosis,[17] and poor preventative care[18] compared with older adults without dementia. They are susceptible to postoperative complications such as delirium[19] and may have reduced access to postoperative rehabilitation[20] following hip fracture compared with individuals without dementia.

However, there have been few large-scale population-based studies of dementia in hip fracture populations, and little is known of the perioperative health service utilization, time to LTC admission, and mortality for individuals with dementia. A better understanding of the impact of dementia on outcomes for older adults with hip fractures will help inform strategies to optimize care for this population and provide important prognostic information for clinicians, patients, and their caregivers. In the current study, we evaluated the postoperative clinical course of older adults with dementia who underwent hip fracture surgery and compared this with older adults with hip fractures who did not have dementia.

Methods

Data Sources

We used several linked population-based administrative healthcare databases available at the Institute for Clinical Evaluative Sciences in Toronto, Ontario, Canada. Each resident in Ontario has a unique identifier based on their health insurance number that is recorded in each of the databases used in this study. This unique identifier can then be used to link an individual's patterns of care across multiple datasets at Institute for Clinical Evaluative Sciences. The Registered Persons Database contains information on age, sex, and date of death for all Ontario residents. The Canadian Institutes of Health Information—Discharge Abstract Database contains information on all hospital admissions and inpatient hospital-based procedures. The Canadian Institutes of Health Information National Ambulatory Care Reporting System contains information on ER visits. All medically necessary inpatient and outpatient physician visits are insured in Ontario and captured in the Ontario Health Insurance Program claims database. Outpatient prescription medications dispensed to individuals 65 years and older are covered by the Ontario Drug Benefits database. Admissions to inpatient rehabilitation hospitals are captured in the National Rehabilitation System database and admissions to complex continuing care (CCC) are recorded in the CCC Reporting System database. Information on home care services in Ontario are recorded in the Ontario Homecare Assessment System and Homecare Databases. The accuracy of these databases has been previously described,[21,22] and our group has used these databases in previous studies of outcomes associated with hip fracture surgery.[23,24]

Study Population

We included all individuals, aged 66 years or older, who experienced a hip fracture (International Classification of Diseases 10: S72.0, S72.1, S72.2) and who underwent hip fracture surgery in Ontario between April 1, 2003 and March 31, 2010. Each individual included in the cohort had a minimum of 1 year of follow-up data available from the date of the index hospitalization in which to capture postoperative outcomes and individuals were censored after 1080 days follow-up. As the Ontario Drug Benefits database only provides universal drug coverage for adults aged 65 and older, we selected 66 years as the lowest eligible age to allow us to describe prescription patterns in the year prior to hip fracture. We excluded individuals who had pathologic hip fractures, hip fractures associated with major trauma, and hip fractures that occurred while in hospital. For individuals with more than 1 hip fracture during the study period, only the first hip fracture was included in the current analyses.

Definition of Dementia

Individuals in the cohort were categorized as having dementia if they had physician-diagnosed dementia in the 5 years preceding the date of the hip fracture. Physician-diagnosed dementia was defined as any outpatient physician visits or hospital admissions in which dementia were recorded as a diagnosis (Supplementary Data 1). This definition of dementia has been utilized in previous population-based studies using administrative databases.[25,26]

Postoperative Outcomes

In Ontario, postoperative care following hip fractures can occur in several settings. Inpatient rehabilitation settings are typically reserved for individuals receiving active rehabilitation programs. CCC often serves as a setting for convalescent care or low-intensity rehabilitation similar to care provided in skilled nursing facilities in the United States. Individuals who are not admitted to CCC or inpatient rehabilitation may receive in-home rehabilitation services through home care. Admission to LTC following hip fracture commonly indicates a permanent transition from the community. In the United States, most individuals with hip fractures are admitted to either skilled nursing facilities or inpatient rehabilitation centers following hip fracture.[20] In contrast, there are fewer inpatient rehabilitation and CCC beds than are required to provide postoperative rehabilitation for all individuals that experience hip fractures in Ontario. Community-dwelling individuals that are not admitted to either inpatient rehabilitation or CCC following hip fracture, but who are unable to return home because of a functional decline following hip fracture, often remain hospitalized within acute care hospitals while awaiting permanent placement in LTC. In Ontario, most individuals who reside in LTC prior to their hip fracture are not considered candidates for either inpatient rehabilitation or CCC as their decreased baseline level of functioning is thought to limit their potential postoperative functional gains and some limited rehabilitation services are available to all LTC residents. As a result, LTC residents are frequently transferred back to the LTC facility they were residing in prior to hip fracture within a relatively short period of time following surgery.

We recorded the total length of stay (LOS) for the index hospitalization. We determined the proportion of individuals with and

without dementia who were admitted to rehabilitation facilities and CCC in the 30 days following surgery as well as the LOS for each group in these settings. Receipt of any home care services in the 30 days following hip fracture was recorded for each individual. For individuals residing in the community prior to hip fracture, the time to LTC admission was compared in the groups with and without dementia. The time from hip fracture surgery until death was also determined for all individuals in the study cohort.

Covariates

We recorded several variables that may be associated with either dementia diagnosis or postoperative outcomes as potential confounders. These variables included demographics (eg, age, sex) and place of residence prior to hip fracture (community or LTC). Medical comorbidity for all participants was assessed in several ways. The total number of outpatient physician visits and visits to dementia specialists (neurologists, geriatricians, and psychiatrists) were determined for each individual in the year preceding hip fracture as markers of clinical complexity. The number of hospitalizations and ER visits in the year preceding hip fracture were also recorded. The Charlson Comorbidity Index score[27–29] was calculated for each individual, along with the number of major adjusted diagnosis groups (ADGs) using the Johns Hopkins adjusted clinical grouping system.[30,31] Several common medical conditions that are risk factors for specific types of dementia were recorded (eg, stroke, Parkinson's disease), along with conditions associated with postoperative morbidity and mortality (eg, chronic obstructive pulmonary disease, ischemic heart disease). Medications known to be risk factors for falls or hip fractures were recorded for all individuals in the 120 days preceding hip fracture. Finally, perioperative variables were recorded including the severity of medical conditions at the time of surgery using anesthesiologist physician billing premiums based on the American Society of Anesthesiology classification.[32] Additional perioperative variables included the type of fracture, type of surgical procedure, anesthetic technique and delay between time of fracture and surgical procedure.

Statistical Analysis

The study cohort was first stratified based on place of residence prior to hip fracture (community vs LTC), given that patient characteristics and postoperative care processes are different for these groups. Within each stratum, baseline characteristics of individuals with and without dementia were compared using the Wilcoxon Rank Sum test for continuous variables and the χ^2 test for categorical variables. Standardized differences were then used to assess for meaningful imbalance in baseline characteristics between patients with dementia and those without dementia, using a threshold of a 10% difference.[33]

Kaplan–Meier survival curves were constructed to describe the cumulative incidence of time to LTC placement for individuals initially residing in the community prior to hip fractures. Survival curves were constructed using Kaplan–Meier methods to determine the cumulative incidence of death for individuals with and without dementia in both the community and LTC strata. A Cox proportional hazards model was then created with dementia as the only predictor of time to death. Covariates were then added to this model to identify potential confounders. A covariate was considered a confounder if the hazard ratio (HR) for dementia changed by 10% or more when the covariate was added to the existing model. In the final Cox proportional hazard model we included age, sex, Charlson score, number of major ADGs, and number of unique medications along with any other variables that met these criteria for confounding. These same covariates were then used in all subsequent multivariable regression models.

For LOS, generalized linear models with a negative binomial distribution and logarithmic link function were used to determine the adjusted association between dementia on LOS[34] within each of the 2 strata. Logistic regression models were used for dichotomous outcomes (eg, admission to rehabilitation). Cox proportional hazards models were then used to determine the adjusted HR and 95% confidence interval (CI) for dementia on time to LTC admission and mortality. The association between dementia on the cause-specific hazard of LTC placement (censoring subjects at time of death if this occurred prior to LTC placement) was first modeled using a Cox proportional hazards model.[35] This was complemented by estimating the cumulative incidence function to estimate the incidence of LTC placement, after accounting for the competing risk of death.[36] The assumptions of all statistical models were assessed for goodness- of-fit. Two-sided *P* values of .05 were used as the threshold for statistical significance for all comparisons. SAS v. 9.3 was used for all statistical analyses (Cary, NC).

Ethics

This study was approved by the research ethics board at Sunnybrook Health Sciences Center in Toronto, Ontario, Canada.

Results

Description of Study Cohort

A total of 45,602 older adults with hip fractures were included in the final study cohort, including 35,952 (78.8%) individuals who were residing in community settings prior to hip fracture and 9650 (21.1%) individuals from LTC. Dementia was common among the cohort with 16,657 (36.5%) of the total cohort having a pre-existing diagnosis of dementia, including 23.9% and 83.5% of individuals from community and LTC settings, respectively.

Among the community cohort, individuals with dementia were slightly older on average (84.4 vs 81.6 years old) and tended to have higher rates of medical comorbidity and health services utilization than those without dementia as evidenced by a higher average number of major ADGs (2.31 vs 1.45), higher rates of ER visits, hospitalizations, and physician visits (Table 1). The distribution of perioperative characteristics for older adults with and without dementia in the community was relatively similar with the exception of American Society of Anesthesiology scores which tended to be higher among individuals with dementia.

Among individuals residing in LTC prior to their hip fracture, the mean age and sex distribution for individuals with and without dementia were similar (Table 1). Individuals with dementia in this group tended to have a greater number of major ADGs but had lower rates of ER visits, hospitalizations, and physician visits compared with those without dementia. In contrast to the community group, most medical conditions tended to be diagnosed less frequently among individuals with dementia when compared with those without dementia in LTC. The distribution of perioperative variables was relatively similar between the 2 groups from LTC.

Health Service Utilization Following Hip Fracture Surgery

The patterns of health service utilization following hip fracture differed significantly between older adults with and without dementia in the community. Compared with community dwelling older adults without dementia, those with dementia in the community had a longer mean index hospital LOS (Table 2). Older adults

Table 1
Characteristics of Older Adults With or Without Pre-existing Dementia Who Underwent Hip Fracture Surgery

	Community Setting				Long-Term Care			
	No Dementia (N = 27,348)	Dementia (N = 8604)	*P* Value	Standardized Difference*	No Dementia (N = 1597)	Dementia (N = 8053)	*P* Value	Standardized Difference*
Demographics								
Age, mean (SD)	81.60 (7.3)	84.49 (6.53)	<.0001	41.73	85.28 (7.24)	85.28 (6.62)	.98	0.00
66–75 years, N (%)	5863 (21.44)	809 (9.40)	<.0001	33.80	154 (9.64)	628 (7.80)	.01	6.54
76–85 years	12,959 (47.39)	3892 (45.23)	.0005	4.31	626 (39.20)	3381 (41.98)	.03	5.68
86 and older	8526 (31.18)	3903 (45.36)	<.0001	29.50	817 (51.16)	4044 (50.22)	.49	1.88
Female sex	20,026 (73.23)	6382 (74.17)	.08	2.15	1194 (74.77)	6087 (75.59)	.48	1.90
Rural community	3834 (14.02)	940 (10.93)	<.0001	9.38	274 (17.20)	1118 (13.90)	.0006	9.05
Medical comorbidity								
Charlson score								
Missing, N (%)	13,303 (48.64)	3161 (36.74)	<.0001	26.74	427 (26.74)	2601 (32.30)	<.0001	12.21
0	6440 (23.55)	3402 (39.04)	<.0001	25.05	400 (25.05)	3352 (41.62)	<.012	6.79
1	2936 (10.74)	855 (9.94)	.035	16.41	262 (16.41)	965 (11.98)	<.0001	12.70
2	1905 (6.97)	506 (5.88)	.0005	11.71	187 (11.71)	491 (6.10)	<.0001	19.80
3+	2764 (10.11)	680 (7.90)	<.0001	20.10	321 (20.10)	644 (8.00)	<.0001	35.37
Number of major ADGs, N (%)								
0	6215 (22.73)	392 (4.56)	<.0001	54.90	198 (12.40)	235 (2.92)	<.0001	36.23
1	9331 (34.12)	1965 (22.84)	<.0001	25.19	523 (32.75)	2202 (27.34)	<.0001	11.81
2	6797 (24.85)	2765 (32.14)	<.0001	16.19	439 (27.49)	2663 (33.07)	<.0001	12.17
3 +	5005 (18.30)	3482 (40.47)	<.0001	50.70	437 (27.36)	2953 (36.67)	<.0001	20.05
Health service utilization								
Number of ER visits in previous year, Mean (SD)	1.08 (1.63)	1.48 (2.09)	<.0001	21.34	1.46 (1.90)	1.25 (1.66)	<.0001	11.77
Number of hospitalizations in previous year, mean (SD)	0.34 (0.80)	0.46 (0.90)	<.0001	14.09	0.65 (1.14)	0.44 (0.84)	<.0001	20.97
Total number of physician visits in previous year, mean (SD)	42.62 (30.39)	50.26 (34.94)	<.0001	23.33	63.68 (47.28)	67.48 (48.79)	.0043	7.91
Any home care service in 90 days preceding hip fracture, N (%)	1662 (6.08)	922 (10.72)	<.0001	16.78				
Medical conditions, N (%)								
Congestive heart failure	5511 (20.15)	2079 (24.16)	<.0001	9.67	582 (36.44)	1989 (24.70)	<.0001	25.70
Chronic obstructive lung disease	8217 (30.05)	2710 (31.50)	.01	3.14	588 (36.82)	2440 (30.30)	<.0001	13.84
Chronic kidney disease	3193 (11.68)	1019 (11.84)	.67	0.52	226 (14.15)	826 (10.26)	<.0001	11.92
Diabetes	6372 (23.30)	2027 (23.56)	.62	0.61	434 (27.18)	1970 (24.46)	.02	6.20
Hypertension	20,624 (75.41)	6609 (76.81)	.008	3.28	1222 (76.52)	5881 (73.03)	.0038	8.04
Ischemic heart disease	10,742 (39.28)	3763 (43.74)	<.0001	9.05	776 (48.59)	3387 (42.06)	<.0001	13.15
Urinary incontinence	4777 (17.47)	1962 (22.80)	<.0001	13.34	369 (23.11)	1589 (19.73)	.0022	8.23
Falls	3733 (13.65)	1702 (19.78)	<.0001	16.49	314 (19.66)	1749 (21.72)	.067	5.08
Osteoarthritis	12,731 (46.55)	4152 (48.26)	<.0057	3.41	798 (49.97)	3578 (44.43)	<.0001	11.11
Medications, N (%)								
Antidepressants	5508 (20.14)	3177 (36.92)	<.0001	37.83	838 (52.47)	4435 (55.07)	.0566	5.22
Antipsychotics	777 (2.84)	1521 (17.68)	<.0001	50.43	304 (19.04)	3855 (47.87)	<.0001	64.18
Benzodiazepine	6172 (22.57)	1975 (22.95)	.46	0.92	638 (39.95)	2584 (32.09)	<.0001	16.43
Perioperative variables								
Extracapsular Fracture, N (%)	12,649 (46.62)	4047 (47.29)	.277	1.57	818 (51.58)	3858 (48.26)	.015	6.63
Hemiarthroplasty, N (%)	11,644 (42.58)	3754 (43.63)	.08	2.13	596 (37.32)	3342 (41.50)	.0019	8.56
ASA 3, N (%)	14,525 (53.08)	4413 (51.97)	.0033	3.65	723 (45.99)	3814 (47.96)	.15	4.19
ASA 4, N (%)	7557 (27.99)	3224 (37.97)	<.0001	21.11	712 (45.29)	3540 (44.52)	.57	1.26
ASA 5, N (%)	164 (0.61)	74 (0.87)	.0093	3.06	22 (1.40)	68 (0.86)	.041	5.09
General anesthesia, N (%)	12,119 (44.31)	3778 (43.91)	.51	0.81	656 (41.08)	3392 (41.12)	.44	2.12
Surgical delay, days, mean (SD)	1.70 (4.26)	1.84 (5.97)	.05	2.70	1.60 (1.91)	1.43 (1.65)	.0015	3.40

ADG, aggregated diagnostic groups; ASA, American Society for Anesthesiology; N, number; SD, standard deviation.
*Standardized differences are a statistical measure of potential imbalance in a variable taking into consideration the study sample size. Standardized differences of ≥10% are indicative of a significant imbalance in a variable between exposure groups.

with dementia were less likely to be admitted to rehabilitation following hip fracture surgery, and when admitted for rehabilitation, had, on average, a shorter rehabilitation LOS compared with older adults without dementia. The presence of dementia was also associated with an increased likelihood of being admitted to CCC and prolonged LOS following admission to CCC (Table 2).

In contrast, individuals with and without dementia from LTC had relatively similar patterns of postoperative health service use. For individuals in LTC prior to hip fracture, dementia was associated with a slightly increased LOS for the index hospital admission, while dementia was not associated with any differences in admission to CCC or LOS in CCC (Table 2). Similar to the community population, older adults with dementia from LTC were less likely to be admitted to rehabilitation following hip fracture and had shorter LOS when they were admitted to rehabilitation.

Long-Term Care Admission and Mortality Following Hip Fracture Surgery

The median time to LTC placement for older adults with dementia who resided in the community prior to their hip fracture was 597 days (approximately 85 weeks), while individuals without dementia had a more prolonged median time to LTC admission (Figure 1). Dementia was associated with a significant increased hazard of LTC placement following hip fracture surgery in both the unadjusted (HR = 2.83; 95% CI: 2.71–2.94, $P < .0001$) and the

Table 2
Postoperative Health Service Utilization of Outcomes of Older Adults With Hip Fractures With and Without Dementia

	Community				Long-Term Care			
	No Dementia (N = 27,348)	Dementia (N = 8604)	*P* Value	Adjusted *P* Value*	No Dementia (N = 1597)	Dementia (N = 8053)	*P* Value	Adjusted *P* Value
Index hospitalization								
LOS in days, mean (SD)	17.45 (21.35)	24.04 (30.48)	<.0001	<.0001	9.99 (8.57)	8.45 (5.52)	<.0001	<.0001
Complex continuing care (CCC)†								
Any admission to CCC within 30 days, N (%)	3814 (13.94)	1629 (19.93)	<.0001	<.0001	41 (2.57)	179 (2.22)	.399	.61
CCC LOS, mean (SD)	57.37 (75.57)	78.98 (151.3)	<.0001	<.0001	108.0 (364.7)	66.41 (166.3)	.249	.43
Inpatient rehabilitation‡								
Admission to inpatient rehabilitation within 30 days, N (%)	11,457 (41.89)	2343 (27.23)	<.0001	<.0001	73 (4.57)	101 (1.25)	<.0001	<.0001
Rehabilitation LOS in days, mean (SD)	153.10 (397.9)	102.5 (276.4)	<.0001	<.0001	70.87 (191.2)	39.89 (189.9)	.29	.0026
Home care service§								
Visit within 30 days, N (%)	4641 (16.97)	1255 (14.59)	<.0001	.28	56 (3.51)	279 (3.46)	.933	.72

ADG, aggregated diagnostic groups; CCC, complex continuing care; LOS, length of stay; LTC, long-term care; N, number; SD, standard deviation.
Complex continuing care refers to inpatient convalescent care or low-intensity long duration rehabilitation similar to that provided in skilled nursing facilities in the US.
*Adjusted for age, sex, Charlson score, number of major ADGs, and total number of medications.
†Length of stay calculated only for those individuals who were admitted to service.
‡Inpatient rehabilitation refers to time-limited active rehabilitation programs in specialized inpatient programs.
§Individuals who reside in LTC may receive additional physiotherapy or occupational therapy services for a brief period following hip fracture surgery which is provided by the same service that administers home care in Ontario.

adjusted (adjusted HR = 2.49, 95% CI: 2.38–2.61, $P < .0001$) analyses. An increased incidence of LTC placement in patients with dementia was also observed in the competing risk analysis obtained using cumulative incidence function analysis (Supplementary Data 2).

Following hip fracture surgery, individuals with and without dementia had high rates of postoperative mortality (Figure 2). Older adults without dementia who resided in the community prior to surgery had a median survival time of 1876 days following hip fracture compared with 1024 days for those with dementia. Dementia was associated with an increased risk of death among older adults in the community prior to hip fracture (HR = 1.80; 95% CI: 1.74–1.86, $P < .0001$), which remained significant after adjusting for confounders (adjusted HR: 1.47, 95% CI: 1.41–1.52, $P < .0001$). For individuals in LTC prior to hip fracture, the median survival time was 639 days for individuals with dementia and 667 days for individuals without dementia. The increased risk of mortality associated with dementia was not statistically significant in the unadjusted analysis (HR = 1.05; 95% CI: 0.98–1.27, $P = .15$), although this association was statistically significant in the adjusted analysis (adjusted HR: 1.10, 95% 1.02–1.18, $P = .005$).

Sensitivity Analysis

A sensitivity analysis for the postoperative health service utilization was undertaken excluding individuals who died within 30 days of the index hospitalization. The differences in LOS and admission rates to inpatient rehabilitation and CCC for individuals with and without dementia continued to be statistically significant after excluding individuals with early mortality. There were also statistically significant differences noted in rates of admission to inpatient rehabilitation and CCC for individuals in the community with dementia compared with individuals without dementia after excluding individuals with early postoperative mortality.

Individuals admitted to CCC or rehabilitation following hip fracture surgery may have a reduced risk of LTC admission as they would not be eligible for LTC while still in hospital. To assess the impact of rehabilitation or CCC admission on the risk of LTC admission associated with dementia, we repeated the Cox proportional hazards analysis excluding individuals who had any admission to rehabilitation or CCC within 30 days of hip fracture surgery. The risk of LTC admission association associated with dementia in this analysis was similar to that obtained in the primary analysis (HR = 2.36, 95% CI: 2.22–2.52, $P < .0001$).

Discussion

Our study provides several important findings regarding the relationship between dementia and hip fractures among older adults. As our study was population-based, we were able to provide estimates of the prevalence of dementia among older adults with hip fractures demonstrating that dementia is very common among older adults with hip fractures. To date there are few studies which have reported on the prevalence of dementia in this population.[13] In our large study sample, individuals with dementia accounted for 24% of hip fractures in community settings and 84% of hip fractures in LTC settings. Information from our study provides important insights about the impact of dementia on hip fracture management and outcomes from a population-based perspective. These findings are important for clinicians, health care administrators, and policy makers. Also, our study evaluates important differences in the prevalence and outcomes of dementia for both community and LTC population, which have not been thoroughly evaluated in previous studies. In our datasets we have access to comprehensive information on postoperative care including information on inpatient rehabilitation, CCC, home care, and LTC services and how dementia impacts on receipt of these services following hip fracture surgery. Overall, individuals with hip fractures and dementia have different trajectories of postoperative care, and they experience several care transitions, which is important in understanding and improving the care of older adults with dementia and hip fractures. Hip fractures were associated with a number of poor health outcomes and healthcare transitions in both groups, and there were marked differences in the patterns of health care utilization associated with dementia, particularly among community-dwelling older adults. Dementia was associated with a further increase in risk of poor postoperative outcomes including elevated rates of LTC placement and mortality. This highlights that individuals with dementia are a high-risk group who likely require specialized care processes to optimize functioning and prevent postoperative complications.

Our finding of increased mortality associated with dementia following hip fracture surgery is consistent with previous literature on risk factors for mortality following hip fracture.[14,20,37–41] Our

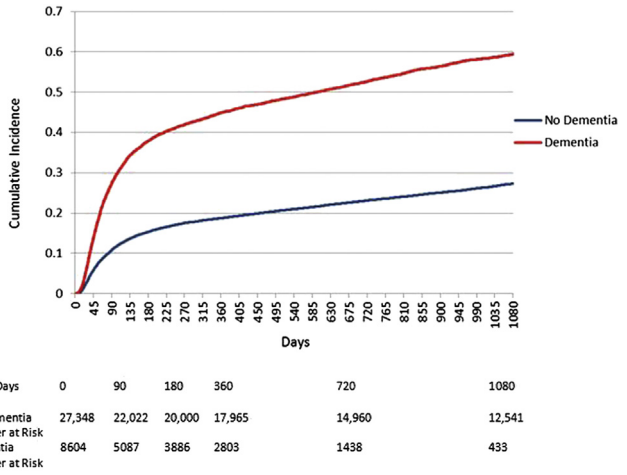

Fig. 1. Cumulative incidence of admission to long-term care admission following hip fractures for older adults with and without dementia.

study provides important population-based information on the effects of dementia on postoperative mortality utilizing information from multiple health care settings to provide results, which are more generalizable to contemporary care settings. In contrast, most previous studies have only evaluated outcomes in small samples collected at single tertiary care centers.[37–41] There are several reasons why dementia may be associated with increased mortality following hip fracture. Dementia is an independent risk factor for the development of some postoperative complications such as delirium,[19,42,43] which is also a major risk factor for postoperative mortality.[44,45] Part of the increased risk may have been due to individuals with dementia having greater severity of medical comorbidity although an elevated risk of death associated with dementia continued to be observed after controlling for these factors. Postoperative care processes such as rehabilitation may provide for better surveillance of postoperative complications while they are in this setting and participation in rehabilitation may help prevent complications which could contribute to mortality. These differences in postoperative care processes were most marked for those individuals with dementia who resided in the community which may have partially accounted for the stronger relationship between dementia and mortality in this group. In comparison, dementia had a smaller effect on postoperative mortality for individuals in LTC where the postoperative care processes for individuals with and without dementia were on average more alike. Given the poor prognosis associated with hip fractures in older adults with dementia, increased efforts to prevent fractures and decrease postoperative complications for this population are required.

For many community-dwelling older adults the occurrence of a hip fracture was often associated with transition to LTC and dementia was associated with an over 2-fold increased risk of LTC admission. Many of the individuals with dementia likely had some degree of functional impairment before hip fracture as home care service use by individuals with dementia was higher than that of individuals without dementia. Hip fractures are often associated with additional declines in functioning,[20,46] which may in turn necessitate LTC admission to meet their increased care needs. Older adults with dementia are particularly susceptible to functional decline following hip fractures,[46–49] and cognitive impairment is a known risk factor for institutionalization following hip fracture.[50,51] The common occurrence of transitions to LTC following hip fracture surgery provides clinicians, patients, and caregivers with important information about the expected course of care following hip fractures. For most patients, caregivers, and policy makers preventing or delaying admissions to LTC following hip fractures is desirable. Further evaluation into optimal ways to support the growing number of older adults with dementia and hip fractures using community-based services will become increasingly important to reduce or delay LTC admissions in this vulnerable population.

Dementia was associated with some differences in postoperative care processes, particularly among those individuals who were residing in community settings. Older adults with dementia in the community were less likely to be admitted to inpatient rehabilitation and more likely to be admitted to CCC following hip fracture indicating that their perceived postoperative care needs may be different. Access to rehabilitation services are one of the key postoperative care processes that may improve function following hip fractures.[52–54] Decreased access to inpatient rehabilitation has also been observed in other populations of older adults with dementia who have had hip fractures,[20] which may be due to clinicians excluding individuals with dementia from rehabilitation due to the perception that this group may derive limited benefit from these services. Although dementia or cognitive impairment has been associated with poor rehabilitation outcomes in some studies,[55–57]

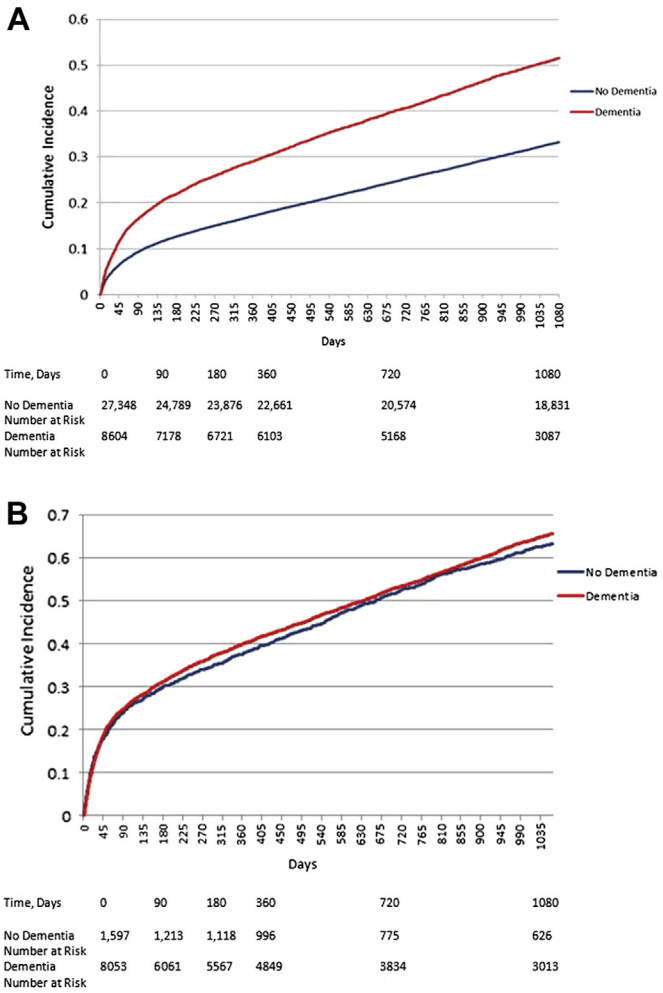

Fig. 2. Mortality following hip fracture for older adults with and without dementia in community and long-term care settings. (A) Cumulative incidence of mortality for individuals with dementia or without dementia following hip fracture surgery for individuals who resided in community settings prior to hip fracture. (B) Cumulative incidence of mortality for individuals with dementia or without dementia following hip fracture surgery who resided in long-term care settings prior to hip fracture.

many individuals with dementia can benefit from rehabilitation and make functional gains following hip fracture surgery especially individuals with mild to moderate dementia who comprise the majority of older adults with dementia in community settings.[58–62] Novel models of rehabilitation services for individuals with dementia have been demonstrated to be effective for this population although these programs require further dissemination to have the greatest impact. Also, the majority of individuals without dementia and hip fractures were not admitted to inpatient rehabilitation services in the postoperative time period which may indicate the need for more broadly available inpatient rehabilitation services in Ontario.

There are several strengths of our study. We have described the outcomes of a large, population-based cohort of older adults with hip fractures in dementia, which may be generalizable to other similar populations. Our study included data from several years that allowed us to examine the long-term outcomes associated with dementia following hip fracture surgery. We also utilized competing risks analysis to evaluate the impact of dementia on admission to LTC which provides a more accurate description of LTC transitions taking into account the high rates of mortality experienced by older adults after hip fracture surgery. Finally, our study included individuals from both community and LTC settings, which provided important information on the impact of dementia on outcomes which differed in these 2 groups.

There are some limitations to our study. First, we did not have detailed information on cognitive performance and functioning in activities of daily living. Second, we only have information available from health service databases and as such we could not control for some factors (such as social support and presence of informal caregivers) that may have an impact on postoperative outcomes. Similar to other studies using administrative databases we were only able to identify individuals as having dementia provided it was clinically recognized. Therefore, it is possible that some individuals with mild dementia may not have been identified. Accordingly, the results of our study may not represent the outcomes of individuals with mild dementia that has not yet been diagnosed by a physician. Although our analysis attempted to control for severity of medical illness, it is possible that residual confounding due to medical illness remains. Given the observed differences in baseline degree of medical comorbidity, the impact of dementia on postoperative mortality may have been overestimated in the community-dwelling group and underestimated among those from LTC. Finally, the overall patterns of postoperative care for our population also reflect the organization of perioperative care for older adults with hip fractures in Ontario and the experience in the United States and other settings may be different where care for this population is organized differently.

Conclusions

Dementia is common among older adults with hip fractures and is associated with different postoperative processes of care and is an independent risk factor for LTC admission and postoperative mortality. A better understanding of the postoperative health trajectories of older adults with hip fractures and dementia provides important information that may inform decision making in the perioperative and postoperative time period. Given the common occurrence of hip fractures among individuals with dementia, clinicians should institute processes to prevent hip fractures in this population. Further study is required to develop effective care processes to reduce postoperative complications and optimize functioning for the vulnerable older adults with hip fractures and dementia.

Supplementary Data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jamda.2013.12.011.

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