Osteoporosis management among residents living in long-term care

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Abstract

Summary—Fractures in long-term care (LTC) residents have substantial economic and human costs. Osteoporosis management in residents with fractures or osteoporosis is low, and certain subgroups are less likely to receive therapy, e.g., those with >5 comorbidities, dementia, and wheelchair use. Many LTC residents who are at risk of fracture are not receiving optimal osteoporosis management.

Introduction—The objective of this study was to describe the prevalence and predictors of osteoporosis management among LTC residents with osteoporosis or fractures.

Methods—In a retrospective study, LTC residents of 17 facilities in Ontario and Manitoba, Canada were investigated. The participants were 65+ years old with osteoporosis, history of hip

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fracture, or recent fracture. Comprehensive assessments were conducted by trained nurse assessors between June 2005 and June 2006 using a standardized instrument, known as the Resident Assessment Instrument 2.0.

Results—Among residents ($n=525$) with osteoporosis or fractures, 177 (34%) had had a recent fall. Bisphosphonate use was reported in 199 (38%) residents, calcitonin use in six (1%), and raloxifene use in six (1%). Calcium and vitamin D supplementation were reported in 140 (27%) residents. Fifty-four (10.3%) residents were on a bisphosphonate but were not taking vitamin D or multivitamin. Variables negatively associated with osteoporosis therapy [OR (95% CI)]: six or more comorbidities [0.46 (0.28–0.77), $p=0.028$], wheelchair use [0.62 (0.40–0.95), $p=0.003$], cognitive impairment [0.71 (0.55–0.92), $p=0.009$], depression [0.54 (0.34–0.87), $p=0.01$], swallowing difficulties [0.99 (0.988–0.999), $p=0.034$] or Manitoba residence [0.47 (0.28–0.78), $p=0.004$]. Prescription of 10+ medications was positively associated with therapy [3.34 (2.32–4.84), $p<0.001$].

Conclusion—Osteoporosis management is not optimal among residents at risk of future fracture. Identifying at-risk subgroups of residents that are not receiving therapy may facilitate closing the osteoporosis care gap.

Keywords

Fracture; Long-term care; Osteoporosis; Treatment

Introduction

The number of hip fractures worldwide has been estimated to increase to 6.3 million in 2050 due to the aging population [1]. Individuals living in nursing homes (or other long-term care settings) are at high risk for hip fractures, such that even after adjustment for confounding factors (including cognitive impairment and chronic illness) their risk remains at least twice that of older adults living in the community [2]. Further, individuals living in long-term care (LTC) are less likely to recover function after a hip fracture than community-living individuals [3]. The costs of hip fracture also vary according to the place of residence. The annual cost of a hip fracture for an acute hospital patient returning to the community in Canada is \$21,385, compared to \$44,146 for those admitted to LTC and \$33,729 for readmissions to LTC [4]. Not only do fragility fractures impose an economic burden but there are also important human costs. Fragility fractures can reduce quality of life, increase fear of falling, and often result in impaired mobility and a loss of independence [5–7]. The 1-year mortality rate after hip fracture has been reported to be up to 25% for individuals returning to the community and 40% for those living in LTC [8]. Given the human and economic burden associated with hip fractures among individuals living in LTC, it is essential that fracture prevention initiatives are implemented.

Therapeutic options can reduce the number of new vertebral compression fractures by 40–60% within the first year in community-living individuals with a fracture [9, 10]. Calcium and vitamin D supplementation in combination can reduce the incidence of hip and non-vertebral fractures among institutionalized individuals [11, 12]. Despite the availability of several therapeutic options for preventing fractures, many community-dwelling individuals

at risk are not being diagnosed and treated for osteoporosis [13–15]. Although individuals living in LTC are at higher risk for fractures, the identification and treatment of osteoporosis among institutionalized individuals may be suboptimal [16–19]. The prevalence of calcium and vitamin D supplementation has been reported to be less than 15% among individuals living in LTC, and only 25% of individuals in LTC with prior hip fractures were receiving calcium and vitamin D [17]. Similarly, a study evaluating both dietary and supplemental sources reported that only 26% and 30% of individuals living in LTC had adequate intake of calcium and vitamin D, respectively [18]. Two recent studies have reported that osteoporosis management (e.g., use of bisphosphonates, calcitonin or calcium, and vitamin D) is poor among LTC residents in the USA with a history of fracture and/or diagnosis of osteoporosis [20, 21]. The purpose of the present study is to describe the extent to which institutionalized individuals in Canada with a history of recent fracture or diagnosis of osteoporosis are receiving osteoporosis management and to identify sociodemographic, clinical, and functional characteristics associated with osteoporosis management. It is hypothesized that osteoporosis management among LTC residents in Canada will be low and that certain subgroups of high risk individuals will be identified that are less likely to receive treatment.

Methods

The sample included 1,909 individuals from 13 LTC facilities across the province of Ontario and four LTC facilities in Manitoba, Canada. Residents aged 65 years or older who were new admissions or existing residents scheduled for assessment were eligible. Comprehensive assessments were conducted by trained nurse assessors between June 2005 and June 2006 using a standardized instrument, known as the Resident Assessment Instrument 2.0 (RAI 2.0). The Office of Research at the University of Waterloo provided ethics approval for the secondary analyses of the anonymized data in the current study.

The RAI 2.0 tool provides a standardized assessment of clients' sociodemographic, physical, and cognitive status, psychological and health conditions, service use and use of prescription, and over-the-counter drugs. The reliability and validity of the tool have been previously established; RAI 2.0 items have excellent inter-rater and test-retest reliability, including in key areas of functional and cognitive status [22–25].

The RAI 2.0 tool includes items for assessing the presence of a diagnosis of hip fracture and osteoporosis, as well as items for assessing the presence of health conditions in the last 180 days, including falls and fractures. All prescribed and over-the-counter medications used by the client in the past 7 days are documented. Individuals were identified as having osteoporosis if they fulfilled any of the following criteria: (1) they had a history of ever having a hip fracture or had sustained a fracture at other skeletal sites within the last 180 days; (2) they had a diagnosis of osteoporosis; or (3) they had been prescribed osteoporosis management. Osteoporosis management was defined as coverage for any of the therapies for osteoporosis prevention and treatment approved for use in 2005–2006, including etidronate, alendronate, risedronate, raloxifene, teriparatide, and calcitonin. Calcium and vitamin D supplementation were not included as osteoporosis management, as it was hypothesized that many residents would be prescribed a multivitamin in lieu of separate calcium and vitamin D, and it would be difficult to discern whether the indication for a multivitamin was

osteoporosis, or whether the dose would be considered adequate for osteoporosis therapy. Further, it is possible that calcium or vitamin D were prescribed in the absence of a diagnosis of osteoporosis. However, descriptive statistics regarding calcium, vitamin D, and multivitamin use are reported.

The following demographic and health-related variables were evaluated as potential correlates of treatment among individuals with osteoporosis including; age, sex, marital status, communication problems, mobility, recent falls, comorbidity, number of prescribed medications, and new medications within the last 90 days. Number of prescribed medications and new medications were derived by the assessors and included as summary items as part of the RAI 2.0. Our analyses also included four health index measures previously developed and validated for use with the RAI 2.0 tool: (1) the Activities of Daily Living (ADL) self-performance hierarchy scale (range 0–6) [26]; (2) the Changes in Health, End-stage disease and Signs and Symptoms (CHESS) score (range 0–5) [27]; (3) the Cognitive Performance Scale (CPS) score (range 0–6) [28, 29]; and (4) the Depression Rating Scale (DRS; range 0–14) [30]. Higher scores are all indicative of more severe impairment. For the ADL and CPS scales, a cut point of 2 was used (at least mild impairment) and a cut point of 3 was used for the DRS (indicating at least mild/moderate depressive symptoms). Variables examined included those deemed relevant based on clinical expertise and previous literature [15].

Analysis

Descriptive statistics for demographic and clinical participant characteristics, as well as use of osteoporosis medication, calcium, vitamin D, and multivitamins are presented as mean (standard deviation (SD)) for continuous variables or count (percent) for categorical variables. Bivariate associations between selected correlates and osteoporosis treatment (among residents with osteoporosis) were examined using unadjusted odds ratios (OR) and 95% confidence intervals and Fisher exact test. To be conservative, predictors found to be statistically significant at $\alpha=0.10$ in bivariate analysis were entered into multivariable logistic regression models. For correlated variables, inclusion in subsequent multivariable analysis was based on previous research findings, clinical relevance, and stratified analyses. Selected variables were then examined in a multivariable logistic regression analysis using the Generalized Estimating Equation approach (with an exchangeable correlation matrix) to account for clustering of residents within facilities [31]. All analyses were performed using the SAS version 9.1 software packages. The criterion for statistical significance for variables in the model was set at $\alpha=0.05$.

Results

Data were available for 1,909 individuals living in 17 LTC facilities, with 13 in Ontario and four in Manitoba (Table 1). Residents were living in facilities located in cities with the following population densities: 44.7% from cities with populations <100,000; 26.3% from cities with populations of 100,000 to 500,000; 28.9% from cities with populations >500,000. Among the total sample, 29% had sustained a fall in the last 180 days, and 10% had sustained a fracture (Table 1); fractures occurred among 16% ($n=90$) of fallers. Individuals

who had sustained a recent fracture or who had a history of hip fracture or documented osteoporosis (from here called the osteoporosis group) represented 27.5% ($n=525$) of the sample (Table 1). Among this group, 55.7% had a documented diagnosis of osteoporosis and 33.7% had experienced a fall in the last 180 days. Females represented 74% of the overall sample, and 88% of the osteoporosis group.

Use of any osteoporosis medication was reported in 11% of the entire group of LTC residents, and 40% of individuals in the osteoporosis group (data not shown). Among individuals who had sustained a recent fracture or who had a history of hip fracture or documented osteoporosis ($n=525$), 37.9% were taking a bisphosphonate (Fig. 1). No residents were taking parathyroid hormone. Twenty-seven percent ($n=140$) of residents in the osteoporosis group were documented to be taking both calcium and vitamin D supplementation. Approximately 6.5% ($n=34$) of LTC residents in the osteoporosis group were documented to be taking calcium supplements only, and 3.6% ($n=19$) were taking vitamin D only. Multivitamin use was reported in 19% ($n=100$) residents in the osteoporosis group. Only 101 (19.2%) residents in the osteoporosis group were taking the recommended therapy (pharmacological therapy plus calcium and vitamin D), and 66 (12.6%) were taking a bisphosphonate and a multivitamin. Further, 54 (10.3%) of residents in the osteoporosis group were taking a bisphosphonate and were not taking vitamin D or a multivitamin.

Logistic regression analyses revealed that several demographic and health-related variables were significantly associated with current use of an osteoporosis therapy among LTC residents with a diagnosis of osteoporosis, hip fracture, or recent fracture. The odds of individuals in this group receiving osteoporosis therapy were lower if they had six or more comorbid conditions, if they used a wheelchair as their primary mode of mobility, if they had cognitive impairment (CPS 2+), if they had depression (DRS 3+), or if they had swallowing difficulties (Table 2). In addition, after adjusting for these various clinical factors, residents of Manitoba facilities had lower odds of receiving osteoporosis therapy. Prescription of ten or more medications was the only variable that was positively associated with current use of osteoporosis therapy among residents with a diagnosis of osteoporosis, hip fracture or recent fracture (Table 2). No significant correlations between variables included in the model were found. There were no significant differences in demographic characteristics when all residents of Manitoba facilities were compared to those from Ontario.

Discussion

The current study reveals that many individuals with osteoporosis or history of fragility fracture living in LTC are not receiving the recommended therapies for osteoporosis and even fewer were taking calcium or vitamin D supplements. The findings are of particular interest as these individuals are at high risk of falls and fractures [2]; 34% had experienced a fall in the last 180 days and 16% of fallers experienced a fracture. The findings of an osteoporosis care gap in LTC residents in Canada are consistent similar studies in the USA [20, 21], with research conducted among home care recipients [15], and community-living individuals with fragility fractures in Canada [14] and internationally [13].

The proportion of residents with osteoporosis or fracture history in the current study who were receiving medication (40%) is comparable to that reported in a recent American study (37%) [20], but higher than that reported in another similar American study (11.5%) [21], which likely reflects the timing of data collection (2005–2006 vs. 2003–2004 and 1995–2004 in the American studies, respectively). Bisphosphonates were the most commonly reported osteoporosis medications in the current study. In contrast, calcitonin use is more common among LTC residents in the US with osteoporosis and fractures [20, 21], one study reported that it was the most commonly prescribed medication [21]. The differences in medication use may again reflect the years in which the data were collected; however, Parikh et al. reported that bisphosphonate use increased and calcitonin use decreased over the 10 years of observation [21]. Differences in drug coverage between the USA and Canada may also exist. At the time the study was conducted etidronate were covered by both provincial drug formularies, and alendronate and risedronate were covered for individuals who met specific criteria (e.g., BMD<3.0 SD below young adult mean, previous fracture, age>75 years). However, calcitonin was not covered in Ontario, and in Manitoba, it was only covered for: (a) the management of pain associated with acute spinal fracture or (b) patients who are intolerant or have a contraindication to bisphosphonates.

Bisphosphonates may be prescribed less frequently among individuals in LTC because of the presence of conditions in which they are contraindicated. Bisphosphonates should not be prescribed for individuals with esophageal motility disorder or esophageal narrowing, or untreated acid reflux [32]. The current study revealed that having swallowing difficulties was negatively associated with osteoporosis management. Similarly, Colon-Emeric et al. reported that having a history of peptic ulcer disease, esophagitis, dysphagia, or alcohol abuse were all negatively associated with use of osteoporosis therapy [20]. The presence of conditions in which bisphosphonate use is contraindicated should not prevent the initiation of other fracture-prevention initiatives (e.g., calcium, vitamin D, and fall prevention).

At a minimum, calcium and vitamin D should be prescribed for individuals in LTC at risk of fractures, since calcium plus vitamin D has been shown to reduce falls and fractures in the LTC population [33, 34]. Low vitamin D and calcium use in Canadian LTC facilities has been reported previously [18], whereas higher usage has been reported among LTC residents in the USA [20]. The use of multivitamins in lieu of calcium and vitamin D supplementation may partially explain in part why LTC residents are not receiving calcium and D separately; however, the doses of calcium and vitamin D obtained in a multivitamin may not be adequate for fracture prevention. A unique observation that is particularly concerning is that 10% of residents were taking a bisphosphonate but were not taking vitamin D or a multivitamin. Alterations in calcium and phosphorus metabolism can occur with bisphosphonate use, so supplemental calcium and vitamin D are recommended [35].

The current study revealed that residents having six or more comorbid conditions, using a wheelchair, having cognitive impairment or depression were less likely to receive treatment; however, these individuals also represent a group that may be likely to fall and experience a fracture. The under-recognition of the need for osteoporosis management among those with depression or who are confined to a wheelchair has also been reported among home care recipients; however, in this group cognitive impairment was associated with a greater

likelihood of receiving osteoporosis management [15]. Similar to the current study, a significant negative association between antiresorptive therapy and cognitive impairment among individuals older than 85 years of age has been reported in a mixed group of community-dwelling and nursing-home residents [36]. A recent American study did not find an association between modified Charlson comorbidity index or dementia and osteoporosis management in LTC residents, perhaps because of the different methods used to define the presence of comorbidities or dementia [21]. There are many possible reasons for less frequent osteoporosis management among individuals with depression, cognitive impairment, wheelchair use, and comorbid conditions including nonadherence, tolerability, length of treatment versus life expectancy or prognosis, prevention of polypharmacy, risk versus benefit or less focus on preventative health than on “presenting” conditions [32]. Among community-dwelling individuals who discontinue osteoporosis therapy, individuals who are older, who have many comorbid conditions or who are admitted to a nursing home are less likely to resume treatment [37]; when combined with the results of the current study these data suggest that indicators for treatment and predictors of continued adherence may be similar.

The observed provincial differences in management also warrant further study. There were no provincial differences in the coverage provided for bisphosphonates at the time of the study, and calcitonin was not covered in Ontario, suggesting that the availability of medications is not the primary reason for the observed provincial differences in osteoporosis management. Only four facilities in Manitoba were included among the 17 facilities, and it is unknown whether these facilities are representative of all facilities in that province.

Some of the predictors of osteoporosis management in LTC residents identified in the current study differ from those identified in previous studies [20, 21]. In a US study, the most powerful predictor of receiving an osteoporosis medication among LTC residents was prior use of the medication in the year preceding the fracture, suggesting that it may not have been the fracture that prompted initiation of treatment [21]. Use of osteoporosis medications prior to fracture was not included as a predictor in the current study as not all residents included had had a fracture. An increased likelihood of osteoporosis management among females has been reported previously among community-living individuals with fragility fractures [14, 38–43], among home care recipients [15] and among LTC residents in the USA [20, 21]. Although gender was not a predictor of treatment in the current study, previous studies reporting that osteoporosis tends to be overlooked in males suggest the need to initiate osteoporosis investigation in males as well as females to ensure that at-risk males receive adequate management. Finally, it appears that some of the predictors identified in the current study (e.g., wheelchair use, depression) were not considered as potential predictors of osteoporosis treatment in LTC residents in previous studies.

The current study has some limitations. It is possible that a history of hip fracture or osteoporosis diagnosis may not have been documented among residents’ charts, and vertebral fractures are not often captured. Individuals with any recent fracture were also included among those in the osteoporosis group; it is not possible to determine fracture type (other than hip fractures) or to differentiate between fragility fractures and traumatic fractures among those with a recent fracture. Inclusion of traumatic fractures would result in

an underestimation of osteoporosis management in the osteoporosis group. Although a large number of residents of LTC facilities were included in the current study, the sample does not include all residents in the included facilities, nor does it include all facilities in Ontario and Manitoba. It is unknown whether there are systematic differences between facilities who are early adopters of the RAI 2.0 compared to those who have not yet implemented the system. Further, dietary intake of calcium and vitamin D are not known. Finally, although being on ten or greater prescription medications was identified as a significant predictor of osteoporosis management, part of the variance explained may be attributable to the osteoporosis medications being one of the total number of medications, as it was not possible to remove them from the total number of medications. The variable was based on clinicians' estimates of the number of medications rather than a count of drugs noted individually on medication list. However, use of nine or more medications has been shown to be associated with osteoporosis management among home care recipients at risk of fracture [15].

In summary, the current study reveals that osteoporosis management is not optimal among individuals at risk of fracture living in LTC facilities in two Canadian provinces. Further, the study identifies predictors of osteoporosis management, which may guide healthcare providers in identifying which residents are not receiving adequate management, such as individuals who use a wheelchair for mobility or individuals with cognitive impairment so that they can attempt to close the osteoporosis care gap in LTC residents. It may be necessary to incorporate an initiative across all LTC facilities that will educate healthcare providers, facility staff, residents, and their families about the importance of fracture prevention strategies. The introduction of the RAI 2.0 as the standard assessment system for long term care in eight Canadian provinces and territories will have the benefit of providing a systematic approach to targeting osteoporosis therapy use to those at high risk of future fracture.

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Fig. 1.
Percentage of residents of 17 long-term care facilities (13 in Ontario, 4 in Manitoba) in osteoporosis group ($n=525$) who are currently taking an osteoporosis medication

Table 1

Demographic characteristics of the total LTC sample and demographic and health characteristics among residents with fracture or osteoporosis diagnosis

Demographic characteristics		Parameter (percentage) <i>n</i> (%)
Total sample (<i>n</i> =1,909)		
Age in years (SD)		84.4 (7.5)
	Aged 65–74	227 (11.9)
	Aged 75–84	745 (39.0)
	Aged 85+	937 (49.1)
Number of females		1,409 (73.8)
Marital status	Married	359 (18.8)
	Widowed	1212 (63.5)
Mean length of stay: years (<i>n</i> =1,891)		2.7 (4.6)
Fall(s) within the last 180 days		554 (29.0)
Fracture(s) within the last 180 days		198 (10.4)
For individuals with fracture or osteoporosis diagnosis (<i>n</i> =525)		
Age in years: mean (SD)		86.2 (7.0)
	Aged 65–74	40 (7.6)
	Aged 75–84	178 (33.9)
	Aged 85+	307 (58.5)
Number of females: <i>n</i> (%)		460 (87.6)
Marital status	Married	67 (12.8)
	Widowed	373 (71.0)
Mean length of stay: years (<i>n</i> =520)		2.5 (4.7)
Osteoporosis diagnosis		292 (55.7)
Diagnosis of hip fracture		181 (34.5)
Diagnosis of other fracture		23 (4.4)
Fracture(s) within the last 180 days		24 (4.6)
Fall(s) within the last 180 days		177 (33.7)
Cognitive impairment (CPS score 2+)		395 (75.2)
Depression (DRS 3+)		118 (22.6)
ADL impairment (ADL score 2+)		485 (92.4)
Mobility	Bedfast	40 (7.6)
	Uses cane	137 (26.1)
	Uses wheelchair	313 (59.6)
Communication problems		366 (82.3)
Health instability (CHESS score 1+)		284 (54.2)
Prognosis of <6 months to live		12 (2.3)
# Comorbid conditions	0–2	80 (15.2)
	3–5	266 (50.7)
	6+	179 (34.1)
Average number of medications: mean (SD)		9.0 (4.8)

Demographic characteristics	Parameter (percentage) <i>n</i> (%)
On 10 or more medications	237 (45.3)
New medications in the last 90 days	239 (47.1)

Table 2

Estimated adjusted odds ratios (95% CIs) for current use of an osteoporosis therapy associated with sociodemographic and health characteristics among LTC residents with a diagnosis of osteoporosis or hip fracture or who had sustained a recent fracture

Variable	OR (95% C.I.)	p Value
Uses wheelchair for mobility	0.62 (0.40–0.95)	0.028
Number of comorbid conditions		
0–2 (reference group)	1.00	
3–5	0.71 (0.43–1.19)	0.194
6 or greater	0.46 (0.28–0.77)	0.003
Number of medications (10 or greater)	3.34 (2.32–4.84)	<0.001
Cognitive Performance (2 or greater)	0.71 (0.55–0.92)	0.0086
Depression (DRS >2)	0.54 (0.34–0.87)	0.010
Province		
Ontario (reference group)	1.00	
Manitoba	0.47 (0.28–0.78)	0.004
Swallowing difficulty (yes)	0.99 (0.988–0.999)	0.034

$n=520$, with 206 on osteoporosis medication; the following variables were significant at $\alpha=0.1$ in bivariate analyses but were not found to be significant predictors of therapy in the multivariable model and were, therefore, not included in the final model: age, female, bedfast, widowed, health instability, uses cane for mobility. The following variables were not found to be significant at $\alpha=0.1$ in bivariate analyses and, therefore, were not tested in the multivariable model: married, widowed, communication problems, prognosis of <6 months to live, new medications in the last 90 days, ADL hierarchy score, and gastrointestinal disease