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Hip Fracture Types in Canadian Men and Women Change Differently with Age: A Population-Level Analysis

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ABSTRACT

BACKGROUND: We have previously reported a gender difference in the occurrence of hip fracture type with age in our local population. In the current report, we have explored this phenomenon in a Canadian population using five years of data from a national administrative database. We have compared community-dwelling and institutionalized individuals to determine if frailty is important and has a differential effect on the type of hip fracture experienced.

METHODS: Hospitalization records from 2005 to 2009, in which the most responsible diagnosis, that is the diagnosis causing the admission to hospital, was a hip fracture, were obtained from the Discharge Abstract Database of the Canadian Institute for Health Information . Hip fracture type was identified using the *Canadian Classification of Health Interventions* and the *International Classification of Diseases 10th Revision, Canada (ICD-10-CA).* Hip fracture proportions were calculated for the study period and stratified by age group and sex.

RESULTS: The relative proportion of intertrochanteric fractures in women rose from 35% in the youngest group (55–59 years) to 51% in the oldest group (84+ years; $P < 0.0001$). In men, the proportions remain relatively stable (47% and 44%, respectively). Community and institutionalized patients showed the same pattern.

CONCLUSIONS: The change in the proportion of the two hip fracture types that occur in women but not men may point to differences in the etiology and consequently the approaches to prevention for the two fracture types. Level of frailty did not seem to be important.

KEYWORDS: osteoporosis, hip fracture types, aging

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Background

We previously reported that in women the proportion of intertrochanteric fractures rises with age, while in men it is the proportion of subcapital fractures that rises.[1] This was found in a study of 2,150 hip fracture patients in London, Ontario (population approximately 350,000), over a five-year period, which was consistent with the findings of others.[2,3] In this report, we have extended the observation to a Canadian population over a five-year period and compared community-dwelling residents with residents in long-term care homes.

It is possible that the two fracture types may have different etiologies. The more common fracture type is the subcapital fracture, which may be less associated with osteoporosis than the intertrochanteric fracture. Patients with intertrochanteric fractures also tend to be older, have more severe bone loss, and have more other fractures, although not all studies agree.[3–8] The structure of the femoral neck may also be important and may influence the type of hip fracture that occurs, with a longer femoral neck and wider neck/shaft angle, favoring a subcapital fracture.[9,10] Although osteoporosis will undoubtedly contribute significantly to the risk of a fracture in a fall, most subjects with a hip fracture have a bone mineral density in the normal or osteopenic range.[11,12] The cause of hip fractures is complicated. Practically, all hip fractures occur in a fall and thus are to some extent traumatic. Additionally, not all falls are the same. The pattern of falling changes with age, with falling in old age being more commonly from a static position to the side and back and onto the greater trochanter.[13] Currently, there is no evidence to suggest that men and women fall differently with age, although it is known that women fall more frequently.[14] There is nothing to suggest that certain fall characteristics influence the type of hip fracture that occurs, although this may be the case for upper limb fractures.[15] It may be that the composition and structure of the hip itself is the determining factor. However, it is possible that matters of frailty in extreme

old age have some effect. It may, for example, affect either the characteristic of the fall or the cushioning of the blow, either by a protective response or by soft-tissue padding, and may influence the hip fracture type. The published data do not point in a definitive direction, as poorer functional state has been shown to be associated more with the subcapital fracture, while poorer health pointed to a greater risk of an intertrochanteric fracture.[7,16] For this reason, we have explored the change in an institutionalized population, presumed to be frailer, and compared this with community dwellers.

It is hoped that a better understanding of how and why the hip fracture types change with age in the two genders, along with an understanding of how some bone characteristics remain stable while others change, might lead to more insight into the prevention of hip fractures. In particular, the relative response to the standard osteoporosis treatments may differ between the two types.

In this cross-sectional study, our goals were to demonstrate on a larger sample the change in fracture type with age in the two gender groups, to offer some insight into the phenomenon, and to compare community-dwelling patients with the frailer institutionalized patients to determine if the pattern is different.

Methods

Data sources. Anonymized hip fracture data were obtained from the Discharge Abstract Database (DAD) of the Canadian Institute for Health Information (CIHI), which manages health and health-care information. CIHI's DAD (www.cihi.ca) collects mandatory discharge statistics from all Canadian health-care institutions by procedures and diagnoses, including administrative, clinical, and demographic information. All hip fracture patients admitted to acute care hospitals are included in the database. The province of Quebec does not contribute to this database and so is not included in our study. The CIHI data contain a single data field for usual living situation and hence institutionalized (residential and long-term care) residents could be identified.

Measures. For this retrospective cross-sectional study, all hospitalization records from 2005 to 2009, in which the most responsible diagnosis was a hip fracture in people over the age of 54 years, were obtained from the CIHI DAD and identified using the *Canadian Classification of Health Interventions* [*CCI*] and the *International Classification of Diseases 10th Revision, Canada* (*ICD-10-CA*). Hip fractures were identified from the ICD-10-CA using diagnosis code S72.0–.2 and from the CCI using diagnosis codes, namely, 1VC74 LANW, 1VA53LAPMN, and 1GZ31CAND. Total annual hip fractures were calculated for the study period (2005–2009) and stratified by age group (5-year intervals with aggregation: 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and ≥85 years) and sex. When a second admission for hip fracture occurred, it was not clear if this was because of complications from the previous fracture, interhospital transfers, or due to a second hip fracture; therefore, all hip fracture hospitalizations were counted.

The Canadian Territories, including the Northwest, Yukon, and Nunavut, were excluded from this study due to their relatively low population base (accounting for only 0.25% of the overall Canadian population).

Statistical analysis. Descriptive analyses of age, sex, and source of admission by fracture type were performed. The Student's *t*-test was used to compare the average age of specific fracture type between the two gender groups. Analysis of the proportion of hip fracture types across age groups in each gender was conducted using the chi-squared analysis. Logistic regression analysis was used to assess the effect of source of admission (community vs. institutional dwelling) on fracture type proportion pattern across age groups in each gender group. All statistical analyses were performed using Statistical Analysis Software (SAS) version 9.2 (www.sas.com).

Results

The database contained a total of 102,842 hip fractures, of which 28,387 (28%) were in men (average age 78 ± 11 years) and 74,455 (72%) were in women (average age 82 ± 10 years). The proportion of the two types of fractures across the age categories for men and women separately is shown in Figures 1 and 2, respectively. Overall, in the population as a whole, the proportion of intertrochanteric fractures increased from 40.4% at the age of 50–64 years to 49.8% in the oldest age group ($P < 0.05$, chi–squared test; Table 1).

It can be seen that the relative rate of the intertrochanteric fracture rises in women from 35.2% in the youngest category to 50.7% in the oldest category ($P < 0.0001$), while in men, the proportions remain relatively stable. Consequently, women with intertrochanteric fractures are significantly older than those with subcapital fractures (84 vs 82 years, $P < 0.0001$), while in men, there is no significant difference in age (79 vs 80 years, $P = 0.48$).

We analyzed the proportion of the two hip fracture types in community and institutionalized patients separately

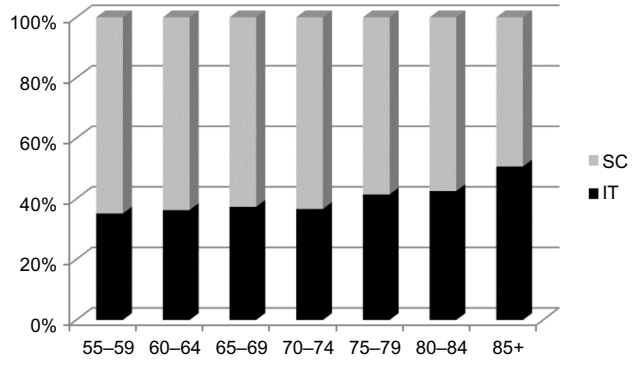

Figure 1. Ratio of intertrochanteric (IT) to subcapital (SC) fractures by age in women.

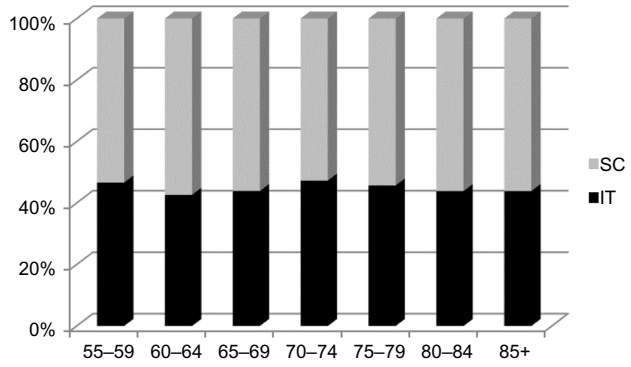

Figure 2. Ratio of intertrochanteric (IT) to subcapital (SC) fractures by age in men.

to explore the possibility that frailty might be more associated with the intertrochanteric fracture. If this is so, then institutionalized men, who are more likely to be frail than their community-dwelling counterparts, would show a tendency to increased intertrochanteric fractures with age. Table 2 shows the distribution of fracture type by type of dwelling. The proportion of intertrochanteric fractures in the community-dwelling subgroup and in the institutional dwelling subgroup is similar (45% and 46%, respectively). Logistic regression showed that frailty does not have a significant effect ($P = 0.38$) on the fracture pattern across age groups in both gender groups. The community and institutionalized patients of the same sex show the same pattern (Figs. 3 and 4).

Discussion

Although the number of hip fractures of both types rises with age, our results confirm that the relative proportion of intertrochanteric and subcapital hip fractures changes across the decades of age in women but not in men. Our data are again consistent with those of others,[2,3] and partly confirm, in the total Canadian population, our previous findings. However, in our smaller study,[1] the proportion of subcapital fractures appeared to rise in men, whereas in this larger sample, it remains unchanged. In our previous report, we conjectured that the greater loss of trabecular bone with age in women may be partly responsible.[1] This observation should give some insight into the causes of the two types of fracture and perhaps some insight into their prevention.

Recent guidelines and risk assessment tools have focused on nonvertebral fractures, including hip fractures, showing these to be best predicted by the cortical bone state as reflected in the neck of femur bone density, a mostly cortical bone site.[17,18] Whether this truly reflects a better prediction by cortical bone measurements or an increasing inaccuracy of spinal density in older life, due to artifact, is not known. Other measurements have been shown to differ between those with and without hip fracture, such as cortical bone thickness and length of femoral neck. However, these measurements have been performed mostly, or totally, in women.[9,10]

Risk factors for subcapital fractures include length of femoral neck and the angle of the neck to the shaft.[9,10] These are fixed measurements and unlikely to change in an individual over time, so the risk of a subcapital hip fracture in the individual will remain constant and be largely determined by the frequency of falling. However, there may be population cohort changes that influence the relative frequency of the two types of fractures over time.[19] On the other hand, intertrochanteric fractures are associated with lower trabecular bone mass and more vertebral fractures.[8,20] These fractures are thus influenced by measurements that change with age, especially in women, and can be altered by treatment. In men, the decline in trabecular bone mass in the population as a whole is much less than in women, so a rising relative rate of intertrochanteric fracture does not occur.[21] Preventing hip fractures in men may be much more difficult if osteoporosis is less of an issue and may need to focus on prevention of falls. It may also be important to exercise caution in extrapolating treatment results from women to men.

Understanding the change in hip fracture type with age, and the different contribution of osteoporosis to each type, may help inform the attempts to reduce hip fracture incidence. It has been questioned whether the use of bisphosphonates has reduced the incidence of hip fractures. The decline in hip

Table 1. Total number and proportion of hip fracture type by sex in different age groups.

	FRACTURE TYPE	AGE	55–59	60–64	65–69	70–74	75–79	80–84	85+
	IT	N (%)	536 (35.2%)	802 (36.3%)	1207 (37.4%)	1998 (36.7%)	4313 (41.5%)	7188 (42.6%)	17645 (50.7%)
Women	SC	N (%)	986 (64.8%)	1405 (63.7%)	2018 (62.6%)	3447 (63.3%)	6076 (58.5%)	9678 (57.4%)	17156 (49.3%)
		Total	1522	2207	3225	5445	10389	16866	34801
Men	IT	N (%)	577 (46.7%)	667 (42.7%)	883 (43.9%)	1435 (47.3%)	2154 (45.7%)	2635 (43.9%)	4315 (43.9%)
	SC	N (%)	659 (53.3%)	896 (57.3%)	1127 (56.1%)	1598 (52.7%)	2557 (54.3%)	3368 (56.1%)	5516 (56.1%)
		Total	1236	1563	2010	3033	4711	6003	9331
Total	IT	N (%)	1113 (40.4%)	1469 (39%)	2090 (39.9%)	3433 (40.5%)	6467 (42.8%)	9823 (43%)	21960 (49.8%)
	SC	N (%)	1645 (59.6%)	2301 (61%)	3145 (60.1)	5045 (59.5%)	8633 (57.2%)	13046 (57%)	22672 (51.4%)

Abbreviations: IT, intertrochanteric; SC, subcapital.

Table 2. Proportion of hip fracture type in community- and institutional-dwelling patients.

	COMMUNITY N = 54966 (53.5%)		INSTITUTIONAL N = 47876 (47.6%)	
	INTERTROCHANTERIC	SUBCAPITAL	INTERTROCHANTERIC	SUBCAPITAL
Women				
N (%)	17514(44.6%)	21763(55.4%)	16175(45.9%)	19003(54.1%)
Age (average)	82.3	80.2	85.2	83.2
Men				
N (%)	7178(45.7%)	8511(54.3%)	5488(43.2%)	7210(56.8%)
Age (average)	78.1	78.4	81	80.9
Total	24692(44.9%)	30274(55.1%)	21663(45.2%)	26213(54.8%)

fracture incidence reported for Canada, with an accelerated rate of decline after 1996, could not be attributed to the spread of the use of bisphosphonates.[22] Also, an investigation into the ability of treatment to reduce the risk assessment calculated retrospectively using FRAX showed that this only occurred in a small fraction of the treated population at the highest risk, presumably those with the worst bones.[23] This raises the possibility that, for most, the drugs are ineffective or the patient targeting is wrong. Notably, in this study, the average age was in the mid-sixties, the age when subcapital fractures predominate. Recently, we have reported that the incidence of hip fracture across the Canadian Provinces did not vary, despite a marked difference in the rate of osteoporosis prescribing.[24] Disappointingly, in this study, even the intertrochanteric fracture was not lower in the areas of greater medication use, and no effect could be seen in the oldest segment of women. One might have expected a reduction in intertrochanteric fractures, although, again, poor targeting may be the problem. Although there is clear evidence that bisphosphonates will reduce the rate of hip fractures in those with low bone density and other evidence of trabecular bone deficiency, such as spinal fractures, any differential effect on the two types of hip fracture has not been explored. In the study by McClung et al.[25], however, it was noted that in the treated group, the fractures that took place were 60% subcapital, which may point to some differential reduction in the intertrochanteric fracture. We have shown previously that the intertrochanteric fracture patients have a greater number of spinal fractures with a distribution similar to that seen in patients with spinal osteoporosis.[26,27] It is possible that strengthening the trabecular bone in the hip might reduce the intertrochanteric fracture but, in the absence of any reduction in falling, increase the subcapital fracture, thereby reducing the overall benefit. Unfortunately, in this study of hip fracture prevention in elderly women, the data to allow this to be assessed were not provided. A reduction in falls, as can be achieved by vitamin D among other interventions, will reduce fracture rate, although whether it differentially reduces one or the other hip fracture type has not been assessed.[28] It is difficult to know whether a reduction in falling at different ages would have a different impact on the two fracture types.

The predominance of the subcapital fracture in younger women suggests that although the loss of trabecular bone during and after the menopause[29] would be expected to compromise the trabecular bone strength, it appears that there is enough left to withstand the fall and transmit the force to the subcapital region. The neck of the femur has relatively little trabecular bone and its removal has little impact on its strength.[30,31] As cortical bone slowly thins, one might expect the risk of the subcapital fracture to rise, but presumably the loss of trabecular bone in older life causes an even greater compromise of the intertrochanteric region that fractures before the force can be transmitted to the neck of the femur. This appears not to happen in men.

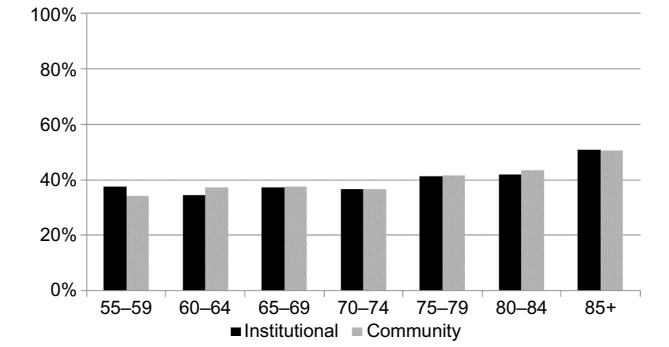

Figure 3. Percentage of intertrochanteric fracture type in women across age groups by dwelling type.

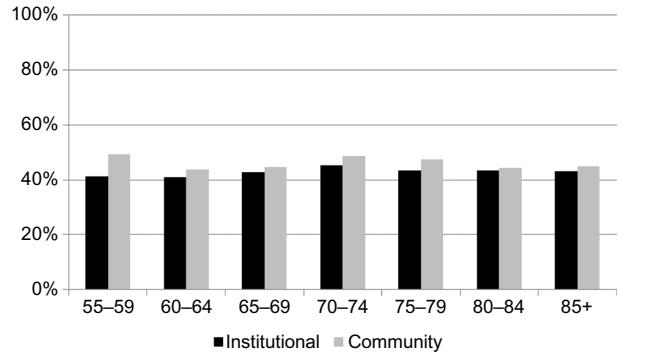

Figure 4. Percentage of intertrochanteric fracture type in men across age groups by dwelling type.

The rate of bone loss has been shown to influence the fragility fracture rate, including that of hip fractures, at least in women, but whether it differentially influences the type of hip fracture has not been studied.[32]

We see no difference in the proportion of the two fracture types in the institutionalized population. These patients are frailer and fall more often.[33] We wondered if frailty, associated as it is with weight loss and declining mobility, might differentially affect trabecular bone and partially account for the rise in intertrochanteric fractures in women. However, this does not seem to be the case as the pattern is the same in institutionalized and community-dwelling women. Likewise, we wondered if this might also be seen in men leading to more intertrochanteric fractures in institutionalized men, but, again, this does not seem to happen. Therefore, frailty may increase the risk, but not influence the type, of hip fracture.

Our study has the usual limitations associated with administrative databases. For example, lack of individual characteristics, such as a measure of frailty, would have confirmed that the institutionalized men and women were more frail, an assumption on our part. However, the study does have the strength of completeness of the capture of all hip fractures associated with a national database.

Conclusions

The changing proportion of the two major hip fracture types, namely, the intertrochanteric and the subcapital, with age differs in the two sex groups, confirming our previous findings in a local sample. The cause of this finding and its implications for the prevention of this important fracture remain obscure.

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Author Contributions

Participated in conceptualization of the study: MK, RGC. Guided data collection: MK, RGC. Participated in data analyses and revised the manuscript: MK. Participated in data analyses and drafted the manuscript: RGC. Managed the database: SM. Performed the analyses: SM. Reviewed and revised the manuscript: SM.

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