Fracture Prevalence and Treatment with Bone-Sparing Agents: Are There Urban-Rural Differences? A Population Based Study in Ontario, Canada

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ABSTRACT. ***Objective.*** To estimate the prevalence of self-reported osteoporotic fractures and use of bone-sparing agents, and to examine if region of residence is associated with fracture or treatment prevalence.
Methods. A census of persons aged ≥ 55 years residing in 2 regions of Ontario, Canada (East York, a region within Toronto, and Oxford County), was completed between 1995 and 1998. Region was coded by record linkage of residential postal codes to 1996 Canadian Census data into 4 groups: East York (urban core), and Oxford County subdivided into: urban core, small urban, and rural. Respondents were excluded if they resided outside the regions of interest or were missing fracture data (5%).
Results. A total of 26,839 persons (15,541 women) were studied. Nearly 3 times as many women as men reported having had an osteoporotic fracture (14% vs 5%), with 31% and 8%, respectively, taking bone-sparing agents. Controlling for age, a diagnosis of osteoporosis, number of osteoporotic fractures, and height loss, women residing in East York were more likely (OR 1.2, 95% CI 1.0–1.4) to be taking a bone-sparing agent other than estrogen, but less likely to be taking estrogen (OR 0.8, 95% CI 0.7–0.9) compared to those living in rural areas. No regional differences were observed in fracture prevalence, treatment among those with an osteoporotic fracture, or use of a bone-sparing agent among men.
Conclusion. Further research into regional differences in osteoporosis screening, treatment, and fractures is warranted. This should examine the appropriateness of possible differences, and separate physician practice patterns from patient characteristics, such as willingness to begin treatment with bone-sparing agents. (J Rheumatol 2005;32:550–8)

Key Indexing Terms:
DRUG THERAPY FRACTURES OSTEOPOROSIS
PREVALENCE RURAL POPULATION URBAN POPULATION

Large regional variation in access to bone mineral density (BMD) testing exists in the province of Ontario, Canada. Regional rates of BMD testing correlate with the location of bone densitometers, which are largely located in urban areas[1]. A survey of family physicians in Ontario found that rural physicians report using BMD tests less frequently, are less likely to have local access, and have less confidence in its use than urban doctors[2]. It is important to further evaluate this regional phenomenon in screening for osteoporosis with BMD testing to see if it translates into practice variation in the prevention and treatment of osteoporosis. The objectives of this study were to estimate the prevalence of osteoporotic fractures and the use of bone-sparing agents, and to examine if region of residence is associated with fracture or treatment prevalence.

MATERIALS AND METHODS

Study population. The Study of Arthritis in Your Community completed a

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census of all persons aged ≥ 55 years living in East York (region within the city of metropolitan Toronto) and Oxford County (including large segments of rural areas). The names and addresses of residents were obtained from residential tax records provided by the Ontario Ministry of Finance. Data collection started in 1995 and ended in 1998. A brief questionnaire was sent to all residents. Those not responding after the second mailing were contacted by telephone to complete the questionnaire by telephone interview. A total of 16,521 women and 11,930 men participated, reflecting a response rate of 77% of those eligible[3]. While the focus of the study was on arthritis, information on self-reported osteoporosis and fractures was collected. Participants residing in East York or Oxford County at the time of survey completion with information regarding fracture history were included in the current study.

Measures: osteoporosis, fractures, and treatment. A diagnosis of osteoporosis was identified by self-reported physician diagnosis. Self-reported fractures of the wrist, arm, hip, rib, pelvis, or vertebrae that were not reported to be due to severe trauma (e.g., motor vehicle accident, fall from stairs, sports injury) and that had occurred after the age of 40 for women and age 50 for men were included as a possible osteoporotic fracture, here referred to as osteoporotic fracture. These fracture sites and ages were selected as they are recognized as being associated with osteoporosis[4]. The use of bone-sparing agents to prevent/treat osteoporosis and fractures were identified by responses to the question: "Have you ever been treated *by a physician* with any of the following medications: estrogen, calcium supplements, vitamin D supplements, didronel/etidronate, fluoride?"; response options were: never, past, or current.

Anthropometric variables. Descriptive characteristics including self-reported body weight and current and tallest height were collected. Height loss was calculated by subtracting current height from tallest height.

Region of residence. Data collected from respondents were linked by postal code to 1996 census data to determine region of residence. Statistics Canada defines urban areas as having a minimum population concentration of 1000 and a density of at least 400/km^2. Rural regions are defined as sparsely populated areas lying outside urban areas. Urban cores are very large urban areas with a population of at least 100,000 and may include surrounding urban areas (population of at least 10,000) that have a high degree of social and economic integration with an adjacent urban core[5].

Given the differences in population density between Metropolitan Toronto, the largest city in Canada, and those residing in an urban core in Oxford County, 2 distinct categories were created to differentiate between those residing within East York and an urban core within Oxford County. Therefore region of residence was stratified into 4 groups: East York, and Oxford County subdivided into: urban core, small urban, and rural.

Statistical analysis. Descriptive statistics of the study participants were summarized as means or proportions. Preliminary analysis identified a significant interaction between age and sex on the prevalence of fracture, therefore all subsequent analyses were stratified by sex. The age and sex-specific proportion of individuals who had sustained at least one osteoporotic fracture was evaluated overall, and separately for fractures of the arm, hip, rib, and pelvis (self-reported prevalence of vertebral fractures were too small for this subanalysis). Correlates of ever taking a bone-sparing agent other than estrogen (calcium, vitamin D, etidronate, fluoride) were evaluated overall, as well as limited to those with a prevalent osteoporotic fracture. Given that estrogen is commonly used to treat menopausal vasomotor symptoms[4], correlates of ever taking estrogen were evaluated separately among women. Analyses were repeated evaluating current use of a bone-sparing agent other than estrogen, and estrogen, separately. The main association of interest was between region of residence and ever/current treatment with a bone-sparing agent other than estrogen, or estrogen. Multivariable logistic regression was used to determine these associations adjusting for age, self-reported diagnosis of osteoporosis, number of osteoporotic fractures, and height loss.

RESULTS

Descriptive statistics and fracture prevalence. Ninety-five percent of respondents were eligible (fracture data and residing in regions of interest) for study (N = 26,839). Half the participants resided in East York. Of those residing in Oxford County, 30% lived in a rural area. Table 1 summarizes descriptive characteristics of the study population stratified by sex. Compared to results in men, women were on average 2 years older, had 3 times as many osteoporotic fractures (14.3% vs 4.9%, respectively), 6 times as many reported a physician diagnosis of osteoporosis (15.6% vs

Table 1. Descriptive characteristics of the study sample by sex.

	Female, n = 15,541		Male, n = 11,298	
	Mean	SD	Mean	SD
Age, yrs	69.2	9.1	67.6	8.5
Weight, kg	66.3	13.1	80.3	13.3
Height, in	63.3	2.7	68.7	2.9
Tallest height, in	63.9	2.6	69.2	2.9
Height loss, in	0.68	0.98	0.53	0.75
	n	%	n	%
Diagnosis of osteoporosis[a]	2072	15.6	257	2.5
Prevalence of osteoporotic fracture[b]	2214	14.3	551	4.9
Wrist/arm	1877	12.1	334	3.0
Hip	342	2.2	103	0.9
Pelvis	62	0.4	12	0.1
Rib(s)	179	1.2	82	0.7
Vertebrae	28	0.2	72	0.6
No. of adult fractures				
1	1776	11.4	478	4.2
2 or more	438	2.8	73	0.6
Estrogen use				
Past	2021	13.9		
Current	2241	15.4		
Ever bone-sparing drug[c]	4096	28.5	764	7.1
Calcium supplement use				
Past	1023	7.1	166	1.5
Current	2689	18.6	368	3.4
Vitamin D supplement use				
Past	308	2.2	111	1.0
Current	1195	8.6	258	2.4
Etidronate use				
Past	73	0.5	22	0.2
Current	232	1.7	64	0.6
Fluoride use				
Past	212	1.6	86	0.8
Current	200	1.5	98	0.9
Region of residence				
East York	8143	52.4	5257	46.5
Oxford urban core	4256	27.4	3288	29.1
Oxford small urban	1024	6.6	762	6.7
Oxford rural	2118	13.6	1991	17.6

[a] Self-reported physician diagnosis. [b] Self-reported fracture of wrist, arm, hip, rib, pelvis, or vertebrae since age 40 (women)/50 (men), not known to be due to a traumatic event. [c] Calcium, vitamin D, etidronate, or fluoride.

2.5%), and 4 times as many had ever been treated by a physician with a bone-sparing agent other than estrogen (28.5% vs 7.1%). However, more men (0.6%) compared to women (0.2%) reported having experienced a vertebral fracture. As would be expected, fracture prevalence increased with increasing age in both sexes, and was significantly higher among women compared to men (Figure 1). The prevalence of osteoporotic fractures increased from 5.1% of women aged 55–59, to 29.3% of women aged ≥ 85 years; and from 2.5% of men aged 55–59 years to 9.9% of men aged ≥ 85. The prevalence of adult fractures were not different by region after adjusting for age and sex (data not shown).

Frequency of treatment with a bone-sparing agent. Figure 2 summarizes the proportion of men and women currently taking a bone-sparing agent, by age. Few women (2.8%, range 1.9–3.6%) or men (1.1%, range 0.8–1.7%) were taking etidronate or fluoride; the proportion did not reveal clinically significant differences or a clear pattern by age. A total of 17.8% of women and 3.3% of men were currently taking calcium and/or vitamin D. Among men, there was a significant increase in the proportion taking calcium and/or vitamin D with increasing age. Although there was no clinically significant difference in the proportion taking calcium and/or vitamin D among women, the proportion taking

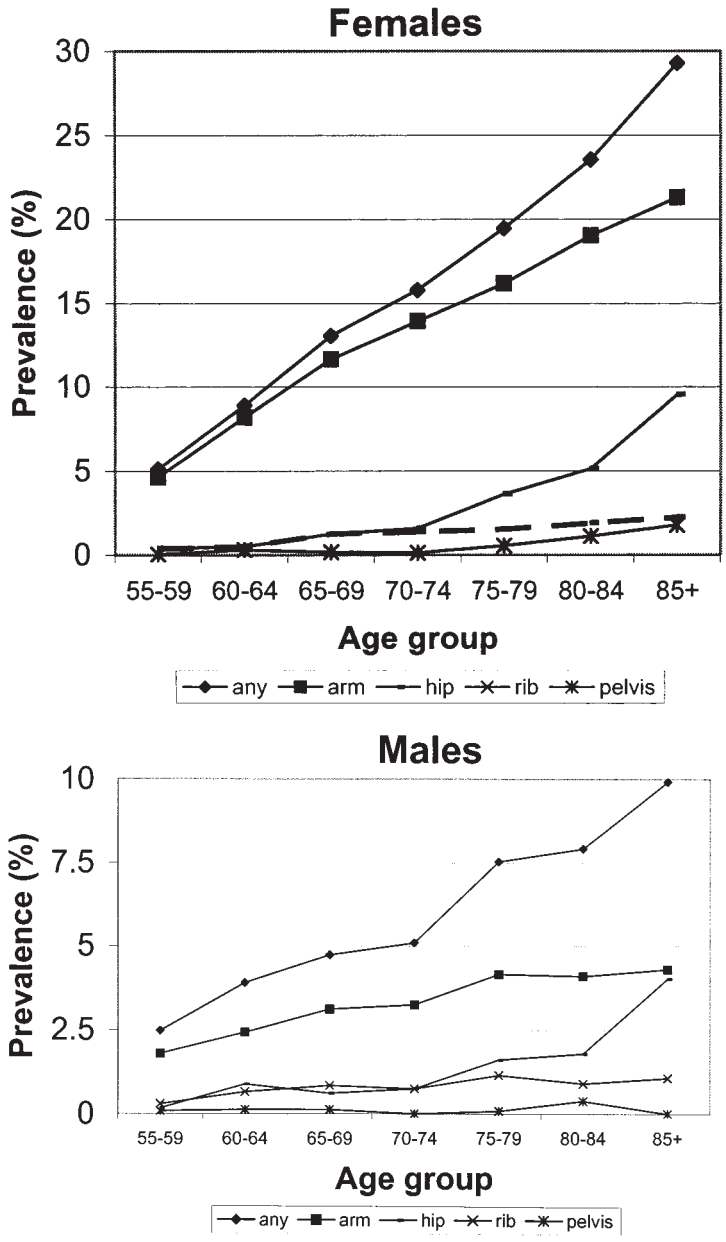

Figure 1. Prevalence of osteoporotic fractures in women (since age 40) and men (since age 50) by age. Any: wrist/arm, hip, rib, pelvis, or vertebrae.

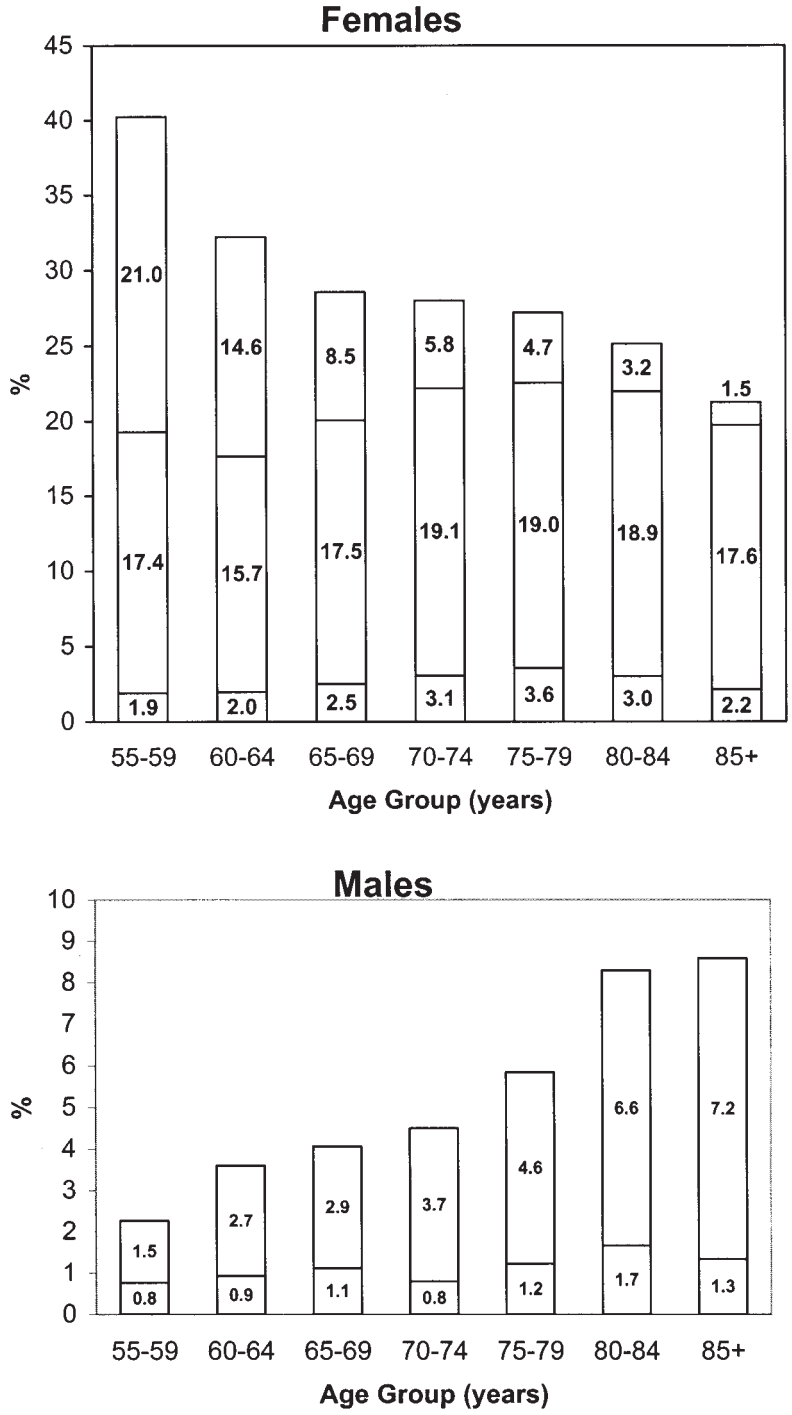

Figure 2. Percentage of men and women currently using bone-sparing agents by age and sex. Bottom panel of each bar: etidronate/fluoride; middle panel: calcium/vitamin D; top panel: estrogen.

estrogen declined with increasing age, from 21.0% to 1.5%.

Association between region of residence and use of bone-sparing agent other than estrogen. Table 2 summarizes the results of bivariate and multivariable logistic regression of ever taking a bone-sparing drug other than estrogen, stratified by sex. In both sexes, osteoporosis, increasing number of osteoporotic fractures, and increasing height loss were positively associated with ever using a bone-sparing agent. While older age was negatively associated with ever taking a bone-sparing agent in women, older age was positively associated with ever taking a bone-sparing agent among men. Women residing in a large urban area (East York or an

Table 2. Odds ratio estimates of ever taking a bone-sparing agent other than estrogen, by sex.

	Women		Men	
	Unadjusted, n = 14,383 OR (95% CI)	Adjusted, n = 9026 OR (95% CI)	Unadjusted, n = 10,823 OR (95% CI)	Adjusted, n = 7633 OR (95% CI)
Age, yrs	1.01 (1.00, 1.01)***	0.99 (0.98, 0.99)***	1.04 (1.03, 1.05)***	1.03 (1.02, 1.04)***
Osteoporosis[a]	6.64 (5.98, 7.37)***	6.22 (5.48, 7.07)***	8.47 (6.40, 11.22)***	6.83 (4.87, 9.58)***
No. of fractures[b]	1.46 (1.36, 1.56)***	1.19 (1.08, 1.32)***	1.69 (1.38, 2.08)***	1.36 (1.03, 1.78)*
Height loss, in	1.42 (1.36, 1.48)***	1.26 (1.20, 1.33)***	1.48 (1.35, 1.62)***	1.34 (1.20, 1.48)***
Region of residence				
East York	1.20 (1.07, 1.34)**	1.18 (1.01, 1.38)*	1.16 (0.93, 1.43)	0.93 (0.72, 1.21)
Oxford urban core	1.19 (1.05, 1.35)**	1.21 (1.02, 1.43)*	1.23 (0.98, 1.55)	1.09 (0.82, 1.45)
Oxford small urban	0.86 (0.71, 1.03)	0.94 (0.72, 1.21)	0.89 (0.62, 1.29)	0.87 (0.55, 1.37)
Oxford rural	1.00	1.00	1.00	1.00

Adjusted analyses include all variables in the table. Bone-sparing agent: calcium, vitamin D, etidronate, or fluoride. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [a] Self-reported physician diagnosis. [b] Self-reported fracture of wrist/arm, hip, rib, pelvis, or vertebrae since age 40 (women)/50 (men), not known to be due to a traumatic event.

urban core within Oxford County) had significantly higher odds of ever taking a bone-sparing agent other than estrogen compared to women residing in rural areas. There was no association with region of residence among men. Similar results were observed when modeling current use of a bone-sparing agent other than estrogen (data not shown). However, the number of fractures lost statistical significance among men; and among women, while those residing in East York were more likely than those living in a rural area (OR 1.26, 95% CI 1.06–1.51) to be taking a bone-sparing agent, there was no difference within regions of Oxford County.

Correlates of taking estrogen among women. Results of multivariable logistic regression of ever and current estrogen use among women were similar, as indicated in Table 3. In contrast to observations for bone-sparing agents other than estrogen, residents of East York had lower odds of ever taking estrogen compared with those residing in rural regions. The magnitude of the odds ratio estimates between a diagnosis of osteoporosis was smaller with ever-estrogen use (OR 2.0, Table 3) compared with ever taking a bone-sparing agent (OR 6.2, Table 2). The number of fractures was not associated with current or ever-estrogen use.

Proportion taking a bone-sparing agent among those with an osteoporotic fracture. Among women with an osteoporotic fracture, 36% had ever been treated with a bone-sparing agent (48% including estrogen), with 27% currently under treatment (31% including estrogen). Among men with an osteoporotic fracture, 11% had ever been treated, with 8% currently taking a bone-sparing agent. Table 4 presents the unadjusted and adjusted results of ever taking a bone-sparing agent other than estrogen among those who had experienced an osteoporotic fracture. Due to small numbers in men, results are presented for men and women together. Results were similar when restricted to women (data not shown). While the odds ratio estimates in urban cores were greater than 1, they were not statistically different from the odds of taking a bone-sparing agent in rural regions. Controlling for age and region, more frequent adult frac-

Table 3. Adjusted odds ratio estimates of estrogen use in women (N = 9126).

	Ever Use OR (95% CI)	Current Use OR (95% CI)
Age, yrs	0.95 (0.95, 0.96)***	0.92 (0.91, 0.93)***
Osteoporosis[a]	1.98 (1.74, 2.25)***	2.04 (1.75, 2.38)***
No. of fractures[b]	0.92 (0.83, 1.02)	0.95 (0.83, 1.08)
Height loss, in	1.15 (1.09, 1.21)***	1.13 (1.06, 1.21)***
Region of residence		
East York	0.86 (0.75, 0.99)*	0.80 (0.67, 0.94)**
Oxford urban core	1.20 (1.03, 1.40)*	1.04 (0.87, 1.25)
Oxford small urban	1.10 (0.88, 1.37)	1.13 (0.87, 1.47)
Oxford rural	1.00	1.00

Adjusted for all variables included in the table. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [a] Self-reported physician diagnosis. [b] Self-reported fracture of wrist/arm, hip, rib, pelvis, or vertabrae since age 40 (women)/50 (men), not known to be due to a traumatic event.

Table 4. Odds ratio estimates of ever taking a bone-sparing agent among those with an osteoporotic fracture.

	Unadjusted, n = 2533 OR (95% CI)	Adjusted n = 1621 OR (95% CI)
Female	4.17 (3.14, 5.52)***	3.13 (2.16, 4.52)***
Age, yrs	1.01 (1.00, 1.02)*	0.99 (0.97, 1.00)
Osteoporosis[a]	8.74 (7.02, 10.87)***	6.44 (4.87, 8.52)***
Number of fractures[b]	1.80 (1.54, 2.09)***	1.37 (1.10, 1.70)**
Height loss, in	1.50 (1.37, 1.64)***	1.21 (1.08, 1.36)**
Region of residence		
East York	1.19 (0.91, 1.55)	1.34 (0.90, 1.99)
Oxford urban core	1.18 (0.88, 1.58)	1.52 (0.99, 2.35)
Oxford small urban	0.73 (0.47, 1.15)	0.76 (0.38, 1.51)
Oxford rural	1.00	1.00

Adjusted for all variables included in the table. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [a] Self-reported physician diagnosis. [b] Self-reported fracture of wrist/arm, hip, rib, pelvis, or vertabrae since age 40 (women)/50 (men), not known to be due to a traumatic event.

tures, increasing height loss, female sex, and having a diagnosis of osteoporosis were all positively associated with ever taking a bone-sparing agent among those with an osteoporotic fracture.

DISCUSSION

Osteoporotic fractures are sentinel events, signaling the need for intervention to prevent the personal and societal costs of subsequent fractures[6,7]. Our study found that 14% of women and 5% of men aged ≥ 55 years have a prevalent osteoporotic fracture. The most common fracture site was the wrist/arm (12% women, 3% men). These estimates are similar to reports of prevalent Colles' fractures in community-dwelling persons (11% women, 3% men; response rate 75%) in the United Kingdom of similar age (mean 69 years, SD 6.3)[8]. The prevalences of hip (2.2% women, 0.9% men) and pelvis (0.4% women, 0.1% men) fractures in our study are also similar to reports from the Canadian Multicentre Osteoporosis Study (CaMos) of persons aged ≥ 50 years (hip: 2.1% women, 1.0% men; pelvis: 0.6% women, 0.2% men)[9]. However, our estimate of self-reported vertebral fractures is lower among women (0.2%) compared with previous reports in Canada by CaMos (1.4%)[9] and reports of postmenopausal women aged ≥ 50 years not currently being treated in the United States (1.2%)[10]. Prior research identifies that self-reported fractures are best at the hip and wrist[11-13]. The surprisingly lower self-reported prevalence of vertebral fractures in women compared to men in our study is likely attributed to underreporting of asymptomatic fractures in women[14] and misclassification of vertebral fractures as osteoporotic in men. Although we excluded fractures known to be due to traumatic events, specific detail on how fractures occurred was not explicitly requested in the questionnaire. We were thus only able to identify traumatic fractures when the participant volunteered this information. Therefore, the higher self-reported prevalence of vertebral fractures in men may be partly due to traumatic fractures (e.g., work related injuries), which are more frequent in men[15]. Indeed, before age 60, hospital admissions for vertebral fractures are higher in men[14].

Treatment of those at high risk for osteoporotic fractures is an important strategy to reduce the burden of osteoporosis on individuals and the community. We found that 29% of women and 7% of men had ever been treated with a bone-sparing agent. The most common form of treatment was calcium and/or vitamin D (19% of women and 3% of men). These estimates are considerably lower than other population based estimates of general calcium supplement use[16,17]. However, they show a similar trend with age (constant) among women with other agents to treat osteoporosis[17]. In addition, current treatment with calcium and/or vitamin D is similar to proportions being treated with bone-sparing agents other than estrogen (19% women and 3% men) in a recent study of persons aged ≥ 51 years presenting to a New England fracture clinic[18]. These data support our assumption that calcium and vitamin D use was for osteoporosis treatment, rather than a simple dietary supplement that may be self-initiated[16,17].

The risk for osteoporotic fracture increases with age, and thus so should osteoporosis treatment. However, this trend was only observed in men. We found that current treatment with a bone-sparing agent increased from 2.5% among men aged 55–59 to 8.5% of men aged ≥ 85 years, but treatment other than estrogen remained relatively constant across the ages (about 20%) in women. Osteoporosis has only recently been recognized as an important health problem in aging men. Focus groups of family physicians in Ontario identify that elderly women and men are not thought about when it comes to osteoporosis prevention[19]. We thus hypothesize that the difference in treatment by age between the sexes may be partly due to more women being treated with agents to prevent osteoporosis and fractures at younger ages, an

inability to distinguish between estrogen therapy for osteoporosis versus other conditions, and a tendency for men to receive treatment for clinically overt osteoporosis (which increases with age) rather than preventive therapy. Given that we cannot identify in which cases estrogen use was for prevention or treatment of osteoporosis compared to other conditions, we are unable to identify the trend between age and treatment among women. Both the finding that estrogen use decreases with increasing age and that osteoporosis treatment other than estrogen remains constant with age in women have been reported previously[17].

Osteoporosis guidelines clearly indicate that patients with a prevalent fragility fracture should receive evaluation for osteoporosis and fracture risk[4,20,21]. Results from this study are consistent with findings that few men or women with fractures receive treatment to prevent recurrent fractures[17,22-25], with only 31% of women and 8% of men with an osteoporotic fracture currently taking a bone-sparing agent. While region of residence was not associated with osteoporotic fracture prevalence or taking a bone-sparing agent among those with a possible osteoporotic fracture, women residing in large urban centers were more likely to have ever been treated with a bone-sparing agent other than estrogen. Given that estrogen may be used for the treatment of several conditions other than bone health, this suggests that osteoporosis prevention by drug therapy may be more likely in large urban areas compared to rural areas. Similarly, BMD testing rates correlate with sites of BMD testing machines, which are largely located in urban areas[1,26].

Research has identified that women are more likely to consider osteoporotic prophylaxis/treatment following BMD testing[27,28]. While a total of 88 BMD testing sites were available in the Toronto regional municipality between 1996 and 1998, only one BMD testing site was available in the whole of Oxford County[1]; the mean age-adjusted rate of BMD tests per 1000 women aged $\geq$ 40 years was 33.6 in Toronto compared with only 4.9 in Oxford County[1]. We found that among those residing in Oxford County, women in its urban core (where the single BMD machine is located) were more likely to have ever been treated with a bone-sparing agent. Therefore, barriers to BMD testing suggested by studies of family physicians[19,29] and administrative data[1,26] may also translate into differences in osteoporosis prevention. Of interest, however, regional differences were not significant when limited to those with established overt osteoporosis (prior fracture). This may suggest that while women living in urban areas are more likely to have a BMD test and thus prevention or treatment of asymptomatic osteoporosis, there are no differences in the secondary prevention of osteoporosis (i.e., the treatment of osteoporotic fractures) by region. That is, in the presence of a fracture, BMD testing is not required to identify risk for osteoporosis and thus prescription with a bone-sparing agent.

When examining current use of bone-sparing agents, women in East York were more likely to be treated with an agent other than estrogen, but less likely to be treated with estrogen. This may suggest that women in rural areas receive preferential treatment with estrogen compared to other types of bone-sparing agents. However, current estrogen use was only moderately associated with osteoporosis, and was not significantly associated with fracture prevalence. This highlights the fact that estrogen is indicated for conditions other than for the prevention and/or treatment of osteoporosis. Our finding that current estrogen use declined with increasing age among women is consistent with other reports[17,30], and supports the notion that estrogen was likely used to treat conditions other than osteoporosis, such as menopausal symptoms. Therefore, it is unclear whether women in rural areas are treated preferentially with estrogen over other bone-sparing agents for osteoporosis, or, in general, more women in rural regions are treated with estrogen for a number of conditions. Part of this difference may be associated with ethnicity; East York is known to be ethnically diverse while Oxford County is relatively homogeneous[3].

An interesting finding is that while osteoporosis treatment was more common in urban areas, no difference in fracture prevalence was observed. This may indicate that higher rates of osteoporosis screening and prophylaxis in urban areas are not cost-effective, occurring in those at low risk for fracture with no effect on osteoporotic fracture prevalence. The cross-sectional design of the study limits our ability to infer conclusions based on the lack of regional differences in fracture prevalence and the presence of differences in treatment. Closer examination of the regional differences in osteoporosis screening and treatment is warranted.

Other limitations of this analysis are centered on how the data were collected. While a census in the 2 regions was completed, participants were recruited into a study focused on arthritis, and thus persons with an interest in arthritis may have been more likely to participate. However, comparison of respondents to the 1996 Census showed that socio-demographically, respondents were highly representative of the Canadian population[3]. Given that results are based on self-report, we may have underestimated the prevalence of osteoporotic fractures, particularly of sites other than the hip and wrist[11-13]. This is highlighted by the small proportion to report having had vertebral fractures, which often go undiagnosed[31]. Nonetheless, self-reported osteoporotic fracture in this study was similar to that in other studies and was strongly associated with use of bone-sparing agents, providing some evidence for the validity of self-reported fractures.

While this study evaluated the use of bone-sparing agents, respondents were not asked about the use of a newer bisphosphonate (alendronate), which received regulatory approval in Canada for the treatment of patients with estab-

lished osteoporosis in 1996[32]. However, this agent required special permission for coverage by the Ontario Drug Benefits Program during the time period of this study. Therefore, while the use of bone-sparing agents may be underestimated in this study, the degree would be small. Regardless of these limitations, the study is population based (77% participation rate), includes data on treatment with calcium and vitamin D use (a limitation of using administrative data[30]), and includes information from men and women residing in both urban and rural regions.

Consistent with previous studies, our study found that osteoporosis treatment is suboptimal, with few men (8%) or women (31%) with an osteoporotic fracture receiving treatment to prevent recurrent fractures. While there was no association between region of residence on the prevalence of adult fractures or with treatment among those with osteoporotic fractures, this study identified small, yet significant associations between region of residence and the use of bone-sparing agents among women. Controlling for age, osteoporosis diagnosis, height loss, and number of possible osteoporotic fractures, women residing in large urban centers were more likely to be treated with a bone-sparing agent (etidronate, fluoride, calcium, and/or vitamin D) than women in rural areas. Prior evidence has suggested that women residing in rural regions of Ontario are less likely to be screened with BMD testing. This study further identifies regional differences in the management of osteoporosis as identified by self-reported treatment with bone-sparing agents among women. Given the study design, we cannot identify the appropriateness of these differences.

Since the survey was conducted, there have been improvements in access to BMD testing in Ontario[26], and newer treatments (bisphosphonates and selective estrogen receptor modulators) have come to market in Canada. Therefore, further research is warranted to determine whether urban-rural differences remain. This research into regional differences in osteoporosis screening, treatment, and fractures should examine the appropriateness of possible differences, and separate physician practice patterns from patient characteristics, such as willingness to begin treatment with bone-sparing agents.

REFERENCES

1. Jaglal SB, McIsaac WJ, Hawker G, Jaakkimainen L, Cadarette SM, Chan BTB. Patterns of use of the bone mineral density test in Ontario, 1992-1998. CMAJ 2000;163:1139-43.
2. Ridout R, Hawker GA. Use of bone densitometry by Ontario family physicians. Osteoporos Int 2000;11:393-9.
3. Hawker GA, Wright JG, Coyte PC, et al. Differences between men and women in the rate of use of hip and knee arthroplasty. N Engl J Med 2000;342:1016-22.
4. Brown JP, Josse RG, Scientific Advisory Council of the Osteoporosis Society of Canada. 2002 Clinical practice guidelines for the diagnosis and management of osteoporosis in Canada. CMAJ 2002;167 Suppl:S1-S34.
5. Statistics Canada. Postal code conversion file reference guide. Ottawa: Minister of Industry; 2002.
6. Klotzbuecher CM, Ross PD, Landsman PB, Abbott TA III, Berger M. Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. J Bone Miner Res 2000;15:721-39.
7. Johnell O, Kanis JA, Odén A, et al. Fracture risk following an osteoporotic fracture. Osteoporos Int 2004;15:175-9.
8. Masud T, Jordan D, Hosking DJ. Distal forearm fracture history in an older community-dwelling population: the Nottingham Community Osteoporosis (NOCOS) study. Age Ageing 2001;30:255-8.
9. Adachi JD, Ioannidis G, Pickard L, et al. The association between osteoporotic fractures and health-related quality of life as measured by the Health Utilities Index in the Canadian Multicentre Osteoporosis Study (CaMos). Osteoporos Int 2003;14:895-904.
10. Siris ES, Miller PD, Barrett-Connor E, et al. Identification and fracture outcomes of undiagnosed low bone mineral density in postmenopausal women: results from the National Osteoporosis Risk Assessment. JAMA 2001;286:2815-22.
11. Chen Z, Kooperberg C, Pettinger MB, et al. Validity of self-report for fractures among a multiethnic cohort of postmenopausal women: results from the Women's Health Initiative observational study and clinical trials. Menopause 2004;11:264-74.
12. Joakimsen RM, Fønnebø V, Søgaard AJ, Tollan A, Størmer J, Magnus JH. The Tromsø Study: registration of fractures, how good are self-reports, a computerized radiographic register and a discharge register? Osteoporos Int 2001;12:1001-5.
13. Ismail AA, O'Neill TW, Cockerill W, et al. Validity of self-report of fractures: results from a prospective study in men and women across Europe. European Prospective Osteoporosis Study Group. Osteoporos Int 2000;11:248-54.
14. Kanis JA, McCloskey EV. Epidemiology of vertebral osteoporosis. Bone 1992;13:S1-S10.
15. Cooper C, Atkinson EJ, O'Fallon WM, Melton LJ III. Incidence of clinically diagnosed vertebral fractures: a population-based study in Rochester, Minnesota, 1985-1989. J Bone Miner Res 1992;7:221-7.
16. Radimer K, Bindewald B, Hughes J, Ervin B, Swanson C, Picciano MF. Dietary supplement use by US adults: data from the National Health and Nutrition Examination Survey, 1999-2000. Am J Epidemiol 2004;160:339-49.
17. Dawson-Hughes B, Harris SS, Dallal GE, Lancaster DR, Zhou Q. Calcium supplement and bone medication use in a US Medicare health maintenance organization. Osteoporos Int 2002;13:657-62.
18. Pro-Risquez A, Harris SS, Song L, Rudicel S, Barnewolt B, Dawson-Hughes B. Calcium supplement and osteoporosis medication use in women and men with recent fractures. Osteoporos Int 2004;15:689-94.
19. Jaglal SB, Carrol J, Hawker G, et al. How are family physicians managing osteoporosis? Qualitative study of their experiences and educational needs. Can Fam Physician 2003;49:462-8.
20. National Osteoporosis Foundation. Physician's guide to prevention and treatment of osteoporosis. Washington, DC: National Osteoporosis Foundation; 2003.
21. Sambrook PN, Seeman E, Phillips SR, Ebeling PR. Preventing osteoporosis: outcomes of the Australian fracture prevention summit. Med J Aust 2002;176:S1-S16.
22. Hajcsar EE, Hawker G, Bogoch ER. Investigation and treatment of osteoporosis in patients with fragility fractures. CMAJ 2000;163:819-22.
23. Cuddihy M, Gabriel SE, Crowson CS, et al. Osteoporosis intervention following distal forearm fractures. A missed opportunity? Arch Intern Med 2002;162:421-6.
24. Gallagher TC, Geling O, Comite F. Missed opportunities for prevention of osteoporotic fracture. Arch Intern Med 2002;162:450-6.

25. Andrade SE, Majumdar SR, Chan A, et al. Low frequency of treatment of osteoporosis among postmenopausal women following a fracture. Arch Intern Med 2003;163:2052-7.
26. Jaglal SB. Bone mineral density testing. In: Stewart DE, Ferris L, Hyman I, Cohen M, Williams JI, Cheung A, editors. Ontario Women's Health Status Report. Toronto: Institute for Clinical Evaluative Sciences; 2002.
27. Fitt NS, Mitchell SL, Cranney A, Gulenchyn K, Huang M, Tugwell P. Influence of bone densitometry results on the treatment of osteoporosis. CMAJ 2001;164:777-81.
28. Pressman A, Forsyth B, Ettinger B, Tosteson AN. Initiation of osteoporosis treatment after bone mineral density testing. Osteoporos Int 2001;12:337-42.
29. Jaglal SB, McIsaac WJ, Hawker G, et al. Information needs in the management of osteoporosis in family practice: an illustration of the failure of the current practice guideline process. Osteoporos Int 2003;14:672-6.
30. Jaglal SB, Jaakkimainen L, McIsaac W, Hawker G, Cadarette S, Wu K. The influence of bone density testing and fractures on prescriptions of bone-sparing medications in elderly women in Ontario, Canada: A population-based study [abstract]. J Bone Miner Res 2001;16 Suppl 1:s194.
31. Ross PD. Clinical consequences of vertebral fractures. Am J Med 1997;103:30S-43S.
32. Scientific Advisory Board, Osteoporosis Society of Canada. Clinical practice guidelines for the diagnosis and management of osteoporosis. CMAJ 1996;155:1113-33.