The osteoporosis care gap in men with fragility fractures: the Canadian Multicentre Osteoporosis Study

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CaMos Research Group**Abstract**

Summary—We examined osteoporosis diagnosis/treatment in 2,187 community dwelling men age 50+. After five years in the study, 90% of men with fragility fractures remained undiagnosed and untreated for osteoporosis. The need to treat fragility fractures is well established in guidelines, and these numbers represent an important care gap.

Introduction—Whether physicians in the community are recognizing and appropriately treating osteoporosis and fragility fractures in men remains unknown. We examined the rate of diagnosis

and treatment in community dwelling men participating in the Canadian Multicentre Osteoporosis Study (CaMos).

Methods—Between February 1996 and September 2002, 2,187 participants were recruited from nine sites across Canada and prospectively followed. Information on osteoporosis diagnosis, fractures, medications were collected annually by a detailed questionnaire. DXA examination of lumbar spine (L1-4) and hip were conducted at baseline and year five.

Results—Diagnosis and treatment in men with clinical fragility fractures was low: at baseline and year five only 2.3% and 10.3% of men with a clinical fracture reported an osteoporosis diagnosis, respectively. At year five, 90% of men with a clinical fragility fracture were untreated. Hip fractures were the most commonly treated (37.5% by year five). A diagnosis of osteoporosis resulted in greater treatment: 67% of participants with diagnosed osteoporosis were treated with a bisphosphonate and 87% were taking calcium and/or vitamin D (year five).

Conclusions—In this population-based study, both a diagnostic and therapeutic gap existed between knowledge and practice related to fragility fractures and osteoporosis in men aged 50 years.

Keywords

Bisphosphonate; Care gap; Diagnosis; Fractures; Males; Osteoporosis

Introduction

Osteoporosis in men is an important health issue. Men account for approximately 20% of all cases of osteoporosis [1] and contribute substantially to the fracture burden. Nearly one third of all hip fractures occur in men [2], and vertebral deformities are similar to or only slightly less common than in women [3–5]. A man's lifetime risk (after age 50) of an osteoporosis-related fracture (termed 'low trauma' or 'fragility' fracture) is 13% to 24% [6, 7]. Compared with women, after a hip fracture men have higher rates of one-year mortality (31–38% for men versus 12–28% for women) [8–10] and are twice as likely to be institutionalized [11]. In Canada, approximately 25% of community-dwelling people move into a nursing home within one year of a hip-fracture [12, 13].

The extent to which osteoporosis and fragility fractures in men are being identified and treated in the community is largely unknown. To our knowledge, this is the first population-based, cohort study to examine this topic in men. Amongst high-risk patient groups who have experienced fractures, it is well documented that fewer than 50% of patients (men or women) are ever assessed or treated for osteoporosis [14–16], despite clear practice guidelines stating that fragility fractures are an indication for therapy [17–19] and place a patient at a higher risk for future fractures [20, 21].

If a large gap occurs between "best practice" and "actual clinical practice" — i.e., a "care gap" — then clearly a greater emphasis needs to be placed on knowledge translation activities aimed at increasing awareness. Given a traditional lack of awareness about this disease in men [22–24], we hypothesized that osteoporosis and fragility fractures would be poorly diagnosed and treated in community-dwelling men. To test this hypothesis, we

prospectively examined men aged 50 years and older who participated in the population-based Canadian Multicentre Osteoporosis Study (CaMos).

Methods

Participants

Initiated in 1996, CaMos is a randomly selected, prospective cohort study of the Canadian population age 16 years and older lasting ten years. The study population represented an age-stratified-, sex- and region-specific sample consisting of 9,423 non-institutionalized individuals (6,539 women and 2,884 men) from nine study centres across Canada (St. John's, Halifax, Quebec City, Toronto, Hamilton, Kingston, Saskatoon, Calgary and Vancouver). CaMos participants were recruited over an 18-month period from lists of random telephone numbers from all postal codes within 50 km of each study centre. Informed consent was obtained from each individual and the study received approval by the institutional review boards at each participating centre [25].

Eligibility and time period

Included in this study cohort were all community-dwelling men 50 years of age and older at baseline. As this was a population-based study, individuals were not selected on the basis of osteoporosis status (it was unknown at the time of recruitment). This cohort was prospectively followed for five years. Baseline assessments took place between February 1996 and September 1997, and the year five assessments took place between February 2001 and September 2002.

Data collection

Baseline and year five assessments included an extensive interviewer-administered questionnaire, lateral lumbar and thoracic spine X-rays, and bone mineral density (BMD) testing. Annually, in the intervening years, participants were mailed a two-page questionnaire regarding fractures, hospitalizations and the use of prescription medications for bone. Participants who did not return their questionnaires were contacted by telephone and asked for their responses to the questions. A follow-up phone call was also made to participants reporting a fracture (i.e., to determine the circumstances and any treatments received).

Self-reported osteoporosis diagnosis and medication use

At the baseline and year five interviews, participants were specifically asked whether a doctor had ever diagnosed them with osteoporosis. We did not perform any review of outside medical records or contact the primary care physician to ascertain the diagnosis. At baseline, participants (or their physicians) were not aware of the study DXA results.

Participants were instructed to bring all of the contents of their medicine cabinets to the interview site. Detailed drug information on osteoporosis therapies and other medications, including type of medication, dose, and frequency of use was documented. Calcium and vitamin D supplementation was also documented. The brief follow-up questionnaires in the intervening years included a list of bone-metabolizing medications and asked the participant

to indicate which types they had taken during the previous year. In Canada, the bisphosphonates etidronate and alendronate were approved for use in women in 1995 (i.e., available at the time of the baseline interviews). Alendronate received approval for men in April 2001 (5 and 10 mg daily dose). Risedronate was released onto the Canadian market in 2000, and received approval for men in December 2006.

Bone mineral density

BMD of the lumbar spine (L1–L4) and femoral neck were measured by DXA using Hologic QDR 1000, 2000, 4500 or Lunar DPX densitometers. Daily machine calibration and daily and weekly quality assurance testing were performed according to manufacturer recommendations. Cross-calibration of densitometers at the nine participating centers occurred at baseline and each year thereafter using a European Spine Phantom. For the two centres which used a Lunar densitometer, BMD results were converted to a Hologic standard using the method by Genant et al. [26].

A report regarding the results of the DXA and X-ray examinations was sent either to the participant, a physician named by the participant or both (dependent on the site). Reports included the absolute bone density (g/cm^2), T and Z-scores. No specific course of action was recommended in the reports; however, at some CaMos study sites it was indicated where appropriate that the participant may be at increased risk for fracture and should be further investigated.

Fractures

Prevalent and incident fractures were self-reported. The baseline questionnaire captured data on prevalent fractures sustained prior to enrolment and the follow-up questionnaires captured data on incident fractures, which occurred during the previous calendar year. Fractures were clinically recognized and resulted from minimal trauma. Prevalent fractures (occurring before CaMos enrolment) were self-reported only; incident fractures (occurring after CaMos enrolment) were substantiated by radiographic reports.

Statistical analysis

Frequency tables for categorical variables and simple statistics for continuous variable were calculated. For all tables/figures, participants who had data in that year are included, whether they dropped out later or not. A ‘diagnosis’ of osteoporosis was based on the self-reported variable from the CaMos interview at baseline and year five. CaMos DXA results were separated into three BMD categories defined by World Health Organization criteria: osteoporosis (T-score -2.5 SD); low bone mass (T-score between -1 and -2.5 SD) and normal bone mass (T-score >-1). Peak bone mass of men in CaMos was used as the DXA reference standard [27]. A participant was classified according to the lowest T-score at either the femoral neck or lumbar spine. Not all participants had a CaMos DXA at baseline and at year five, and as a result denominators vary.

The number of men reporting an osteoporosis therapy (yes/no: bisphosphonate, calcitonin, fluoride) for each study year (baseline to year five) was examined for men with clinical fractures and men reporting a diagnosis of osteoporosis.

Clinical fractures were assessed cumulatively over the five-year observational period (i.e., fracture variables included all fractures prior to that year, not only in the previous 12 months.) Participants were divided into five fracture groups, including: hip, wrist, rib, spine, and all clinical fractures, except fingers, toes, face and skull. All analyses were performed using SAS 9.1.3.

Results

A total of 2,187 men 50 years of age and older participated in this five-year prospective study. A total of 52 men were lost to follow-up after baseline, the remainder contributed data to at least one subsequent year. Table 1 displays the baseline characteristics of participants and those lost to follow-up after the baseline assessment.

CaMos DXA results were available for 1,907 and 1,448 men at baseline and year five, respectively. Of these men, the percentage of men with a T-score ≤ -2.5 was 6.3% (N=121) at baseline and 5.9% (N=86) at year five. The percentage of men who reported a diagnosis of osteoporosis was 1.3% (N=24) at baseline and 8.6% (N=125) at year five. Figure 1a,b display the BMD status (i.e., based on CaMos DXA) of men who reported a diagnosis of osteoporosis at baseline and year five, respectively. Of men with a diagnosis of osteoporosis, approximately 1 in 3 had a clinical fragility fracture (baseline and year five).

Diagnostic care gap

At baseline, 20.2% (441/2,187) of men had a prevalent clinical fragility fracture at any site (excluding skull, fingers, and toes); only 2.3% (10/441) of these men also reported a diagnosis of osteoporosis. At year five, 10.3% (39/379) of men with a clinical fragility fracture (incident or prevalent) reported a diagnosis of osteoporosis.

Therapeutic care gap

Figure 2 shows bisphosphonate treatment rates for all clinical fragility fractures over the five-year period (rates are presented for bisphosphonates since so few men were taking any other osteoporosis medication). At baseline, <1% (2/441) of men with a fragility fracture were taking a bisphosphonate; by year five the treatment rate for any fragility fracture was 9.5% (36/379).

The greatest increase in treatment from baseline to year five occurred for hip fractures, with an overall percent change of 29.2% (95% CI: -7.8 , 66.2). At year five, 37.5% (3/8) of hip fractures were treated, followed by 25% (2/8) of vertebral fractures, 17.7% (11/62) of rib fractures, and 8.7% (10/115) of wrist fractures. None of the pelvis fractures were treated (0/4).

Figure 3 displays the proportion of men with a self-reported diagnosis of osteoporosis taking bisphosphonates and calcium and/or vitamin D.

Discussion

We observed both a diagnostic and therapeutic care gap in community-dwelling men (over age 50) with fragility fractures. Ours is the first prospective, population-based study to comprehensively examine this topic in men. The low diagnosis and treatment rates we observed are in keeping with previous cross-sectional studies in women and men [15, 16, 24]. Several key points should be noted:

First, fragility fractures were not triggering a diagnosis of osteoporosis. At baseline, 2.3% of men with a clinical fragility fracture reported being diagnosed with osteoporosis by a physician. Even at year five, despite participation in an osteoporosis study (which had the potential to raise awareness about osteoporosis and fractures in the patients and their physicians), only 10% of men with a fragility fracture reported a diagnosis of osteoporosis.

Second, treatment rates were similar to diagnostic rates for men with fragility fractures: no more than 10% ever received treatment for osteoporosis (Fig. 2). Men with hip fractures were the most commonly treated, however <40% of these received treatment. Wrist fractures were the most common type of fracture; <10% of wrist fractures were treated with a bisphosphonate.

These are alarming figures considering that individuals with a fracture are at a two-four fold risk for another fracture [20, 21] and due to the availability of medications that reduce fractures and improve BMD in men [28–31]. Although bisphosphonates were not approved for use in men during the majority of the study time period, off-label use may have occurred and the 1996 Clinical Practice Guidelines clearly state that etidronate and alendronate had regulatory approval in Canada for the treatment of patients with established osteoporosis: those with pre-existing fragility fractures and those who meet bone-density criteria for osteoporosis. Risedronate became available in 2000.

Third, a diagnosis of osteoporosis resulted in greater treatment. By year five, 67% of participants with diagnosed osteoporosis were treated with a bisphosphonate and 87% were taking calcium and/or vitamin D (Fig. 3). However, as described above, physicians were not recognizing osteoporosis in a high-risk group — men with fragility fractures.

It is evident that increased educational and knowledge transfer initiatives are needed and indeed welcomed by some primary care groups. In a survey of primary care physicians practising in the United States, 70% believed there is a need for increased primary care education regarding the management of osteoporosis in patients hospitalized with fragility fractures [32]. In a Canadian survey conducted in 2001 (364 family physicians responded) [33], 85% indicated it was important for them to be better informed about BMD testing and osteoporosis treatments. Interestingly, only 58% of the respondents indicated that fragility fractures ‘influenced very much’ their decision to order a BMD test. Additionally, 35% of respondents had not read the osteoporosis treatment guidelines [18] published in a general Canadian medical journal. Of physicians who were interested in receiving an osteoporosis risk assessment tool, the most preferred dissemination method was by direct mail, followed by continuing medical education events, and problem-based small group learning.

Several practice-based knowledge translation initiatives are currently underway to improve the identification and treatment of patients with fragility fractures. These include the Fracture, Think Osteoporosis Program (FTOP) [34], the Osteoporosis Exemplary Care Program [35], and a multi-faceted improvement project that included development of *STOP Osteoporosis* software [36]. In order to reduce costs associated with treating fractures, with the growing population of older men, there is a need to focus on new approaches aimed at the early identification and treatment of osteoporosis in men with fragility fractures.

Some limitations of this study need to be addressed. It is possible that the level of awareness regarding osteoporosis and fragility fractures in men has increased since this study began. However, more recent reports indicate that the state of osteoporosis and fracture care is still not adequate [15, 16]. Indeed our estimates likely represent the best-case scenario, since awareness regarding osteoporosis may have been greater for the men participating in our study (CaMos DXA results were also sent to some physicians).

Although participants were randomly selected, participation in CaMos was completely voluntary and thus subject to a non-response bias. Kmetz et al. [37] examined non-response bias in CaMos (42% of individuals who were contacted agreed to fully participate in CaMos) by applying multiple imputation to the CaMos data. Results suggested little nonresponse bias in terms of BMD status, except perhaps in the very elderly. Whether diagnostic and treatment rates would be affected by non-response has not been examined. If it were assumed that CaMos participants might be more likely to seek physician advice and access treatment, then the diagnostic and therapeutic care gap seen in our study may actually be underestimated.

Another potential limitation is that the group of men who were lost to follow-up by year five may have been different from those who remained in the study. Compared with those who remained, a greater percentage of men who were lost to follow-up were in the 70–79 and 80+ categories (Table 1). Given that older men are more likely to be afflicted with osteoporosis and fractures than younger men (and in our study, more likely to be treated; data not shown), it is possibly that any bias which occurred as a result of loss to follow-up resulted in an underestimation of our prevalence estimates. On other characteristics, the cohort of men who were lost to follow-up was similar to CaMos participants who remained.

Lastly, we may have underestimated the rate of prescribed osteoporosis treatments, since medications that were prescribed but not taken regularly by the patient, or were not kept in the medicine cabinet, may have been left out of the treatment count during CaMos interviews.

Conclusion

In this five-year study, a critical diagnostic and therapeutic care gap existed in randomly selected Canadian men with fragility fractures. Even if many men view osteoporosis as a “woman’s disease”, health care providers should be aware of men who are at high risk for osteoporosis and fractures, particularly men who have already experienced a fragility fracture. Given the significant threat to lost mobility and independence, and the high rate of

fracture-associated mortality, the osteoporosis care gap in men presented here should be a ‘wake-up call’ for physicians, public health officials, and other health care providers. To reduce the fracture burden, clearly greater knowledge translation activities and innovative educational programs are needed to improve the gap between best practice and actual practice.

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References

1. National Osteoporosis Foundation. America's bone health: the state of osteoporosis and bone health. National Osteoporosis Foundation; Washington, DC. USA: 2002.
2. Cooper C, Campion G, Melton LJ 3rd. Hip fractures in the elderly: a world-wide projection. *Osteoporos Int.* 1992; 2:285–289. [PubMed: 1421796]
3. Pluijm SM, Tromp AM, Smit JH, et al. Consequences of vertebral deformities in older men and women. *J Bone Miner Res.* 2000; 15:1564–1572. [PubMed: 10934655]
4. Burger H, Van Daele PL, Grashuis K, et al. Vertebral deformities and functional impairment in men and women. *J Bone Miner Res.* 1997; 12:152–157. [PubMed: 9240738]
5. Jackson SA, Tenenhouse A, Robertson L. Vertebral fracture definition from population-based data: preliminary results from the Canadian Multicenter Osteoporosis Study (CaMos). *Osteoporos Int.* 2000; 11:680–687. [PubMed: 11095171]
6. Kanis JA, Johnell O, Oden A, et al. Long-term risk of osteoporotic fracture in Malmo. *Osteoporos Int.* 2000; 11:669–674. [PubMed: 11095169]
7. Melton LJ 3rd, Chrischilles EA, Cooper C, et al. How many women have osteoporosis? *JBMR Anniversary Classic. JBMR, Volume 7, Number 9, 1992. J Bone Miner Res.* 2005; 20:886–892. [PubMed: 15931736]
8. Forsen L, Sogaard AJ, Meyer HE, et al. Survival after hip fracture: short- and long-term excess mortality according to age and gender. *Osteoporos Int.* 1999; 10:73–78. [PubMed: 10501783]
9. Jiang HX, Majumdar SR, Dick DA, et al. Development and initial validation of a risk score for predicting in-hospital and 1-year mortality in patients with hip fractures. *J Bone Miner Res.* 2005; 20:494–500. [PubMed: 15746995]
10. Hawkes WG, Wehren L, Orwig D, et al. Gender differences in functioning after hip fracture. *J Gerontol A Biol Sci Med Sci.* 2006; 61:495–499. [PubMed: 16720747]
11. Osnes EK, Lofthus CM, Meyer HE, et al. Consequences of hip fracture on activities of daily life and residential needs. *Osteoporos Int.* 2004; 15:567–574. [PubMed: 14730422]
12. Marottoli RA, Berkman LF, Leo-Summers L, et al. Predictors of mortality and institutionalization after hip fracture: the New Haven EPESE cohort. Established populations for epidemiologic studies of the elderly. *Am J Public Health.* 1994; 84:1807–1812. [PubMed: 7977922]
13. Papaioannou A, Wiktorowicz M, Adachi JD, et al. Mortality, independence in living, and re-fracture, one year following hip fractures in Canadians. *J Obstet Gynaecol Can.* 2000; 22:591–597.
14. Elliot-Gibson V, Bogoch ER, Jamal SA, et al. Practice patterns in the diagnosis and treatment of osteoporosis after a fragility fracture: a systematic review. *Osteoporos Int.* 2004; 15:767–778. [PubMed: 15258724]
15. Papaioannou A, Giangregorio L, Kvern B, et al. The osteoporosis care gap in Canada. *BMC Musculoskelet Disord.* 2004; 5:11. [PubMed: 15068488]

16. Giangregorio L, Papaioannou A, Cranney A, et al. Fragility fractures and the osteoporosis care gap: an international phenomenon. *Semin Arthritis Rheum.* 2006; 35:293–305. [PubMed: 16616152]
17. National Osteoporosis Foundation. Physician's Guide to Prevention and Treatment of Osteoporosis; [about 1 screen]. Washington, DC. USA: National Osteoporosis Foundation; c2003. homepage on the Internet[cited June 2006]Available from: <http://noforg/physguide/>
18. Clinical practice guidelines for the diagnosis and management of osteoporosis. Scientific Advisory Board, Osteoporosis Society of Canada. *CMAJ.* 1996; 155:1113–1133. [PubMed: 8873639]
19. Brown JP, Josse RG. 2002 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada. *CMAJ.* 2002; 167:S1–S34. [PubMed: 12427685]
20. Kanis JA, Johnell O, De Laet C, et al. A meta-analysis of previous fracture and subsequent fracture risk. *Bone.* 2004; 35:375–382. [PubMed: 15268886]
21. Klotzbuecher CM, Ross PD, Landsman PB, et al. Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. *J Bone Miner Res.* 2000; 15:721–739. [PubMed: 10780864]
22. Phillipov G, Phillips PJ, Leach G, et al. Public perceptions and self-reported prevalence of osteoporosis in South Australia. *Osteoporos Int.* 1998; 8:552–556. [PubMed: 10326060]
23. Juby AG, Davis P. A prospective evaluation of the awareness, knowledge, risk factors and current treatment of osteoporosis in a cohort of elderly subjects. *Osteoporos Int.* 2001; 12:617–622. [PubMed: 11580074]
24. Hajcsar EE, Hawker G, Bogoch ER. Investigation and treatment of osteoporosis in patients with fragility fractures. *CMAJ.* 2000; 163:819–822. [PubMed: 11033708]
25. Kreiger N, Tenenhouse A, Joseph L, et al. The Canadian Multicenter Osteoporosis Study (CaMos): background, rationale, methods. *Can J Aging.* 2002; 18:376–387.
26. Genant HK, Grampp S, Gluer CC, et al. Universal standardization for dual x-ray absorptiometry: patient and phantom cross-calibration results. *J Bone Miner Res.* 1994; 9:1503–1514. [PubMed: 7817795]
27. Tenenhouse A, Joseph L, Kreiger N, et al. Estimation of the prevalence of low bone density in Canadian women and men using a population-specific DXA reference standard: the Canadian Multicentre Osteoporosis Study (CaMos). *Osteoporos Int.* 2000; 11:897–904. [PubMed: 11199195]
28. Sawka AM, Thabane L, Papaioannou A, et al. A systematic review of the effect of alendronate on bone mineral density in men. *J Clin Densitom.* 2005; 8:7–13. [PubMed: 15722581]
29. Ringe JD, Faber H, Farahmand P, et al. Efficacy of risedronate in men with primary and secondary osteoporosis: results of a 1-year study. *Rheumatol Int.* 2006; 26:427–431. [PubMed: 16001181]
30. Sawka AM, Papaioannou A, Adachi JD, et al. Does alendronate reduce the risk of fracture in men? A meta-analysis incorporating prior knowledge of anti-fracture efficacy in women. *BMC Musculoskelet Disord.* 2005; 6:39. [PubMed: 16008835]
31. Orwoll E, Ettinger M, Weiss S, et al. Alendronate for the treatment of osteoporosis in men. *N Engl J Med.* 2000; 343:604–610. [PubMed: 10979796]
32. Simonelli C, Killeen K, Mehle S, et al. Barriers to osteoporosis identification and treatment among primary care physicians and orthopedic surgeons. *Mayo Clin Proc.* 2002; 77:334–338. [PubMed: 11936928]
33. 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 guideline implementation process. *Osteoporos Int.* 2003; 14:672–676. [PubMed: 12879224]
34. Papaioannou A, Coker E, Kennedy CK, et al. A multi-faceted post fracture care model: the fracture? Think osteoporosis! Program. *J Bone Miner Res.* 2004; 19:S318.
35. Bogoch ER, Elliot-Gibson V, Beaton DE, et al. Effective initiation of osteoporosis diagnosis and treatment for patients with a fragility fracture in an orthopaedic environment. *J Bone Joint Surg Am.* 2006; 88:25–34.
36. Harrington JT, Barash HL, Day S, et al. Redesigning the care of fragility fracture patients to improve osteoporosis management: a health care improvement project. *Arthritis Rheum.* 2005; 53:198–204. [PubMed: 15818644]

37. Kmetz A, Joseph L, Berger C, et al. Multiple imputation to account for missing data in a survey: estimating the prevalence of osteoporosis. *Epidemiology*. 2002; 13:437–444. [PubMed: 12094099]

a

Total N= 1907. Osteoporosis: T-score $\leq$ -2.5 SD; Low Bone Mass: T-score between -1 and -2.5 SD; Normal: T-score $>$ -1.

b

Total N= 1448. Osteoporosis: T-score $\leq$ -2.5 SD; Low Bone Mass: T-score between -1 and -2.5 SD; Normal: T-score $>$ -1.

Fig. 1.

a: CaMos DXA status of men reporting an osteoporosis diagnosis at baseline **b:** CaMos DXA status of men reporting an osteoporosis diagnosis at year five

*Clinical Fragility Fracture=Spine, Hip Pelvis, Rib, Wrist; Years 1 to 5 include both prevalent and incident fractures.

Fig. 2.
Percentage of men with clinical fragility fracture(s)* taking bisphosphonates

Fig. 3.

Percentage of men reporting an osteoporosis diagnosis* taking bisphosphonates, calcium/vitamin D

*Total number of men with an osteoporosis diagnosis: N=24 at baseline and N=125 at year five.

Table 1

Baseline Characteristics

Characteristics: No. (percent)	Men N=2,187	Lost to follow-up* N=52
Age (yr)		
50–59	602 (27.5)	12 (23.1)
60–69	759 (34.7)	7 (13.5)
70–79	629 (28.8)	18 (34.6)
80+	197 (9.0)	15 (28.9)
Clinical fragility fracture	441 (20.2)	10 (19.2)
Family history of fracture ^a	1,304 (59.6)	27 (51.9)
Ever smoked	1,634 (74.7)	42 (80.8)
Bisphosphonate use	7 (0.3)	0
Osteoporosis medication use ^b	9 (0.4)	0
Calcium or vitamin D use	651 (29.8)	15 (28.9)
Regular activity program	1,215 (55.6)	26 (50.0)

* Men who left the study after baseline

^a Includes parents, siblings and children

^b Includes bisphosphonate, calcitonin, or fluoride