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ORIGINAL ARTICLE

A randomized study of two different information-based interventions on the management of osteoporosis in minimal and moderate trauma fractures

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Abstract *Introduction:* Despite the high risk for subsequent fracture following an initial osteoporotic fracture, the majority of subjects with minimal trauma fractures receive no treatment for osteoporosis. The primary aim of this investigation was to determine whether an information-based intervention could change post-fracture management of osteoporosis. A secondary aim was to define participant- and doctor-related barriers to osteoporosis management. *Methods:* Consecutive fracture patients (n=254) from the outpatient fracture clinic at St Vincent's Hospital, Sydney were interviewed over a 15-month period (February 2002–July 2003). Fracture risk factors, prior investigation and treatment for osteoporosis were collected at baseline. Participants were initially contacted after 3 months to ascertain follow-up management. All those not investigated or treated by their primary care physician were then randomized to either a personalized letter or the same letter plus an offer of a free bone mineral density (BMD) test. Participants were contacted after 9 months to record further investigations or treatment for osteoporosis. *Results:* Less than 20% of the participants had a primary care physician follow-up 3 months after the fracture, leaving 159 who were randomized to a personalized letter (n=79) and a personalized letter plus the offer of a free BMD test (n=80). There was a significant increase in the number of people investigated for osteoporosis in the group receiving the letter plus BMD offer [38% (letter + BMD) vs. 7% (letter only); p=0.001). A high proportion of those tested had low BMD (49% osteopenia and 17% osteoporosis). However, the rates of treatment in both groups were very low (6%). Furthermore, even among the few individuals (23%) who contacted their primary care physician, only 25% were recommended treatment. The belief that the fracture was osteoporotic was an independent predictor of having a BMD test, a primary care physician follow-up and treatment. Other independent predictors were age over 50 years for a primary care physician follow-up, female sex for having a BMD test and having had a BMD test for treatment. *Conclusion:* This study demonstrates that an information-based intervention led to a modest increase in the proportion of people investigated for osteoporosis; however. there was no significant effect on treatment rates. The offer of a free BMD assessment was associated with a significantly higher rate of investigation than a personalized letter alone (odds ratio: 8.5; 95% confidence interval: 3.1–24.5), but this investigation did not affect treatment rate. The low uptake of either a BMD or a visit to a primary care physician together with low rates of treatment recommendation even among people who contacted their primary care physician reflects significant participant and doctor-related barriers to osteoporosis management.

Keywords Barriers to osteoporosis treatment · Fracture · Osteoporosis management · Post-fracture intervention

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Introduction

Osteoporotic fractures represent a major health problem in most developed countries [1–3], as they result in disability, deformity, increased mortality and significant health-care costs [3–5]. The disease currently affects 1.9 million Australians, 1.4 million Canadians and 10 million Americans [3, 6, 7]. It is expected that 42–56% of all women and 27–29% of all men will develop osteoporotic fractures after the age of 50 years and, due to aging populations, it is predicted that the number of fractures will increase by 4% per annum [2, 3, 8, 9]. The studies that assess prevalence of fractures in the community usually include only fragility fractures defined as fractures caused by a fall from standing height or less [10–12]. However, there is evidence that

people with higher-energy trauma fractures may also have low bone density [13] and may be at increased risk of subsequent fracture [14]. Thus, the potential burden of bone fragility fracture may be far greater than is currently realized.

A prior fragility fracture represents an increased risk for subsequent fracture independent of bone density [15–19]. Several guidelines indicate that bone mineral density (BMD) should be investigated in all people with low trauma fractures and treatment if necessary [3, 20, 21]. Despite this recommendation, osteoporosis is under-investigated and under-treated even in the high-risk group of people who have been hospitalized for a fracture [10–12, 22, 23–32]. The few studies that have assessed post-fracture management of osteoporosis in both genders have reported that men are even less likely to be considered for osteoporosis intervention than women [12, 25, 27].

There is little explanation for this lack of treatment. Barriers to osteoporosis investigation and treatment seem to be associated with both doctors and patients. A recent study investigating the practice of post-fracture management of osteoporosis found that orthopaedic surgeons regard the general practitioner (GP) as the person responsible for any medical treatment after a fracture [33], while the primary care physicians are often not convinced that the efficacy of osteoporosis therapy warrants the attendant costs and potential adverse effects [34]. On the other hand, patient-related barriers, such as the lack of knowledge of osteoporosis and its complications along with an unwillingness to accept osteoporosis treatment, can also contribute to the problem [35, 36]. Another recent study conducted in Netherlands found that only 15% of participants with fragility fractures were prescribed treatment for osteoporosis and, of those, over 50% discontinued treatment after less than a year [25]. However, this study did not investigate the reasons for treatment discontinuation. To our knowledge, patients' barriers to treatment have not been addressed in men. To provide more information in this area, we therefore included both men and women in this study.

The primary aim of this study was to determine whether an information-based intervention could improve the proportion of women and men investigated and treated for osteoporosis after a minimal or moderate trauma fracture compared to standard post-fracture management. A secondary aim was to evaluate the barriers to post-fracture primary care physician follow-up, investigation and treatment for osteoporosis.

Materials and methods

The study cohort consisted of consecutive men and women followed-up for a minimal or moderate trauma fracture in outpatient fracture clinics at St Vincent's Hospital, Sydney, over a 15-month period from February 2002 to July 2003. Medical notes of all patients attending the fracture clinics were reviewed prior to the clinic, and all fracture patients were prospectively identified for interview. A total of 568 individuals being treated for a fracture were approached. The exclusion criteria were fractures due to major trauma (e.g. motor vehicle accidents, fall from more than ten steps), finger or toe fracture, individuals younger than 20 and overseas tourists. Individuals already on specific therapy for osteoporosis were not further analysed.

Study design

The study was designed as a longitudinal, randomized study of two information-based interventions for those participants who had not been investigated or treated for osteoporosis 3 months after the fracture (Fig. 1). The first intervention consisted of a personalized version of a standard letter addressed to the participant. The letter noted the participant's risk factors for osteoporosis and recommended follow-up with their primary care physician. The second intervention consisted of the same personalized letter but included an offer of a free BMD assessment.

Randomization method

A block randomization procedure was used in order to keep the numbers of subjects in different blocks closely balanced at all times [37]. Participants were also stratified by trauma group (minimal and moderate), gender and age. To eliminate any potential bias, the randomization procedure was conducted by a person not involved in any other part of the study (NI).

Data collection and measurements

Baseline information included the circumstance surrounding the fracture, risk factors for osteoporosis [history of fractures (>12 years); corticosteroid use; age at menopause; family history of osteoporosis; intercurrent conditions, such as lung diseases and rheumatoid arthritis], dietary calcium intake, prior investigation [dual X-ray absorptiometry (DXA) scans] and treatment for osteoporosis. All fractures were confirmed radiologically. Fractures were classified as minimal trauma if they occurred following a fall from standing height or less. Moderate trauma was recorded if the fracture occurred following a sporting injury (e.g. a fall while running, playing tennis, dancing or soccer, but excluding high trauma sports such as rollerblading skiing, etc) or a fall from a ladder or stairs (but less than ten steps).

Three months following the fracture, a standardized telephone interview was conducted to collect information on any subsequent investigation and treatment for osteoporosis. Participants not investigated or treated for osteoporosis were then randomly allocated to each of the two intervention groups (Fig. 1). The BMD results of those who had had the test performed were sent with a cover letter suggesting follow-up with their primary care physician.

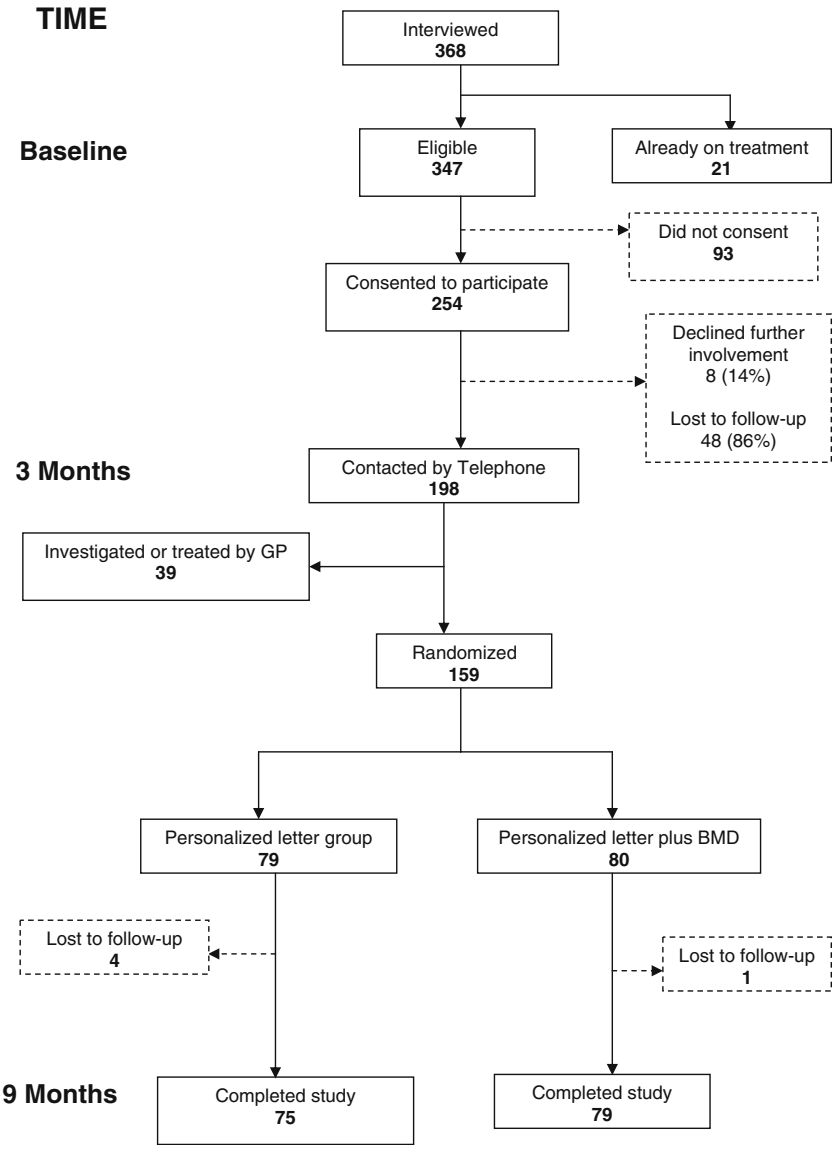

Fig. 1 Flow-chart of participants' selection and follow-up

Six months following randomization, a second standardized telephone interview was performed on all participants. Information on any further investigation and treatment for osteoporosis as well as follow-up advice from their primary care physician was obtained.

All information was collected and recorded on standard questionnaire forms by one investigator (DB).

Ethics approval: This study was approved by the St Vincent's Hospital Human Research Ethics Committee.

Statistical methods

Sample size

The 3-month follow-up, which reflected the usual post-fracture care, demonstrated that only 20% of participants had had a primary care physician follow-up after the fracture, and even fewer were investigated or treated for osteoporosis. Our pilot data showed that the letter plus BMD intervention increased the rate of investigation by more than 25% versus the letter-alone intervention. Using a two-tailed α-value of 0.05 and allowing for a 10% loss to follow-up, a total sample of 140 would be required to observe a 25% difference in outcome with a power of 80%.

Statistical plan

Clinical and demographic characteristics of the two intervention groups were compared using the T-test for continuous variables and the chi-square analyses for categorical variables.

The three study outcomes – rates of primary care physician follow-up, investigation and treatment for osteoporosis – were compared between the two intervention groups using chi-square analysis.

Separate uni- and multivariate regression models were created to determine the independent factors associated

with primary care physician follow-up, investigation and treatment for osteoporosis, independent of the randomization group.

All statistical analyses were performed using SAS software ver. 8.2 (SAS, Cary, N.C.).

Results

Of the 568 people screened: 116 suffered major trauma, 32 were younger than 20, 26 were overseas visitors, 15 had mental illnesses, eight sustained finger or toe fractures, two were deaf and one was blind. Of the 368 eligible individuals, 93 declined involvement. Another eight participants declined further study involvement at the 3-month follow-up after having given initial consent. These 101 individuals who declined full participation had the same age, gender and fracture type distribution as those who consented to participate. Twenty-one participants were on anti-resorptive treatment at baseline.

Of the 246 eligible and consenting participants, 198 were interviewed at a 3-month telephone interview and 48 were lost to follow-up. Of the 198 participants followed-up, 39 (20%) were investigated and/or treated by their primary care physician. The remaining 159 were then randomized into the personalized letter group (n=79) or personalized letter plus BMD offer group (n=80). Among these 159 participants, five were unable to be contacted at the 9-month telephone interview (Fig. 1).

The 53 participants lost to follow-up were younger (mean age ± SD: 37±15 vs. 52.7±19 years; p<0.01) and more likely to have suffered a moderate trauma fracture (57 vs. 33%; p=0.01) than the rest of the cohort but had the same gender distribution.

Baseline characteristics of participants

Of the 193 participants, 67% (n=129) had minimal trauma and 33% (n=64) had moderate trauma fractures. The mean age of the cohort was 52.7±19 years and 60% (n=119) were females.

Distal forearm fracture was the most frequent fracture (37%), irregardless of gender and trauma type, followed by lower limb fractures (27%), with more ankle fractures (17%) in the minimal trauma group and more tibia and fibula fractures (25%) in moderate trauma group (Table 1). Fracture type differed by age in women but not in men. For women younger than 50, the predominant fractures were lower limb (n=22; 61%), followed by forearm (n=10; 28%). The lower limb fractures included 11 ankle, seven tibia and fibula and four foot fractures. In women over 50 years of age, the predominant fracture type was forearm (n=24; 49%), followed by humerus (n=12; 24%). In men, forearm fracture was the most common for both those younger (n=11; 26%) and for those older than 50 years (n=9; 33%). Tibia and fibula were the next most common fracture (26% for those younger than 50 and 19% for those older than 50).

Almost half of participants (48%) had had prior fractures. Other common risk factors included a family history of osteoporosis (27%), low calcium intake (37%), smoking (23%), and early menopause in women (21%). These did not differ by trauma fracture type.

Three-month follow-up and randomization

Only 39 participants (20%) had an osteoporosis-related primary care physician follow-up 3 months after the fracture. Of these, 23 had already been investigated for osteoporosis prior to this fracture. Of these 23 participants, ten had a further BMD scan following the fracture. Another 13 participants had an initial BMD scan after the fracture, and three participants had started anti-resorptive therapy for osteoporosis without any investigation.

The remaining 159 participants, who had not had any osteoporosis-related primary care physician follow-up, were randomized to the personalized letter group (n=79) or to the personalized letter plus BMD group (n=80). Participants in the two intervention groups had similar types of fracture and there were no differences in gender, age, fracture site distribution, history of prior fracture, low calcium intake or family history of osteoporosis (Table 2).

Investigation and/or treatment unrelated to study intervention

Twenty-one participants were on anti-resorptive therapy for osteoporosis at baseline and subsequently excluded from further analyses. These participants were older (mean age ± SD: 73.4±11 vs. 52.7±19; p<0.0001) and more likely to be female (86 vs. 60%; p=0.025) and have suffered a

Table 1 Fracture site in participants stratified by gender and type of fracture

Fracture site/type	Women		Men	
	Minimal (n=64)	Moderate (n=21)	Minimal (n=34)	Moderate (n=35)
Forearm	26 (41%)	8 (38%)	9 (26%)	11 (32%)
Hip, femur, pelvis	6 (9%)	3 (14%)	4 (12%)	4 (11%)
Upper limb[a]	12 (19%)	1 (5%)	8 (24%)	4 (11%)
Lower limb[b]	20 (31%)	9 (43%)	13 (38%)	16 (46%)

[a]Upper limb includes humerus and clavicle fractures
[a]Lower limb includes tibia and fibula, ankle and foot fractures

Table 2 Baseline demographic and clinical characteristics according to intervention groups

Characteristics	Intervention groups[a]		
	Letter alone group (n=75)	Letter plus BMD group (n=79)	p-value
Age			
<50 years	35 (47)	43 (54)	
≥50 years	40 (53)	36 (46)	0.2
Type of fracture			
Minimal	48 (64)	50 (63)	
Moderate	27 (36)	29 (37)	0.9
Gender			
Female	38 (51)	47 (59)	
Male	37 (49)	32 (41)	0.2
Prior fracture	38 (51)	33 (42)	0.3
Family history	16 (21)	18 (23)	0.8
Low calcium (<700 mg/dl)	26 (35)	30 (38)	0.7
Early menopause[b] (≤45 years)	6 (25)	6 (23)	0.9
Current smokers	21 (28)	20 (25)	0.7
Steroid use	7 (9)	2 (3)	0.08
Conditions associated with bone loss[c]	3 (4)	5 (6)	0.5

[a]Values represent the numbers of participants in each category. Values in parentheses represent the percentage of participants in each category
[b]Twenty-four postmenopausal women in the letter group and 26 in the letter plus BMD group
[c]Includes rheumatoid arthritis, hyperthyroidism, malabsorption and Crohn's disease

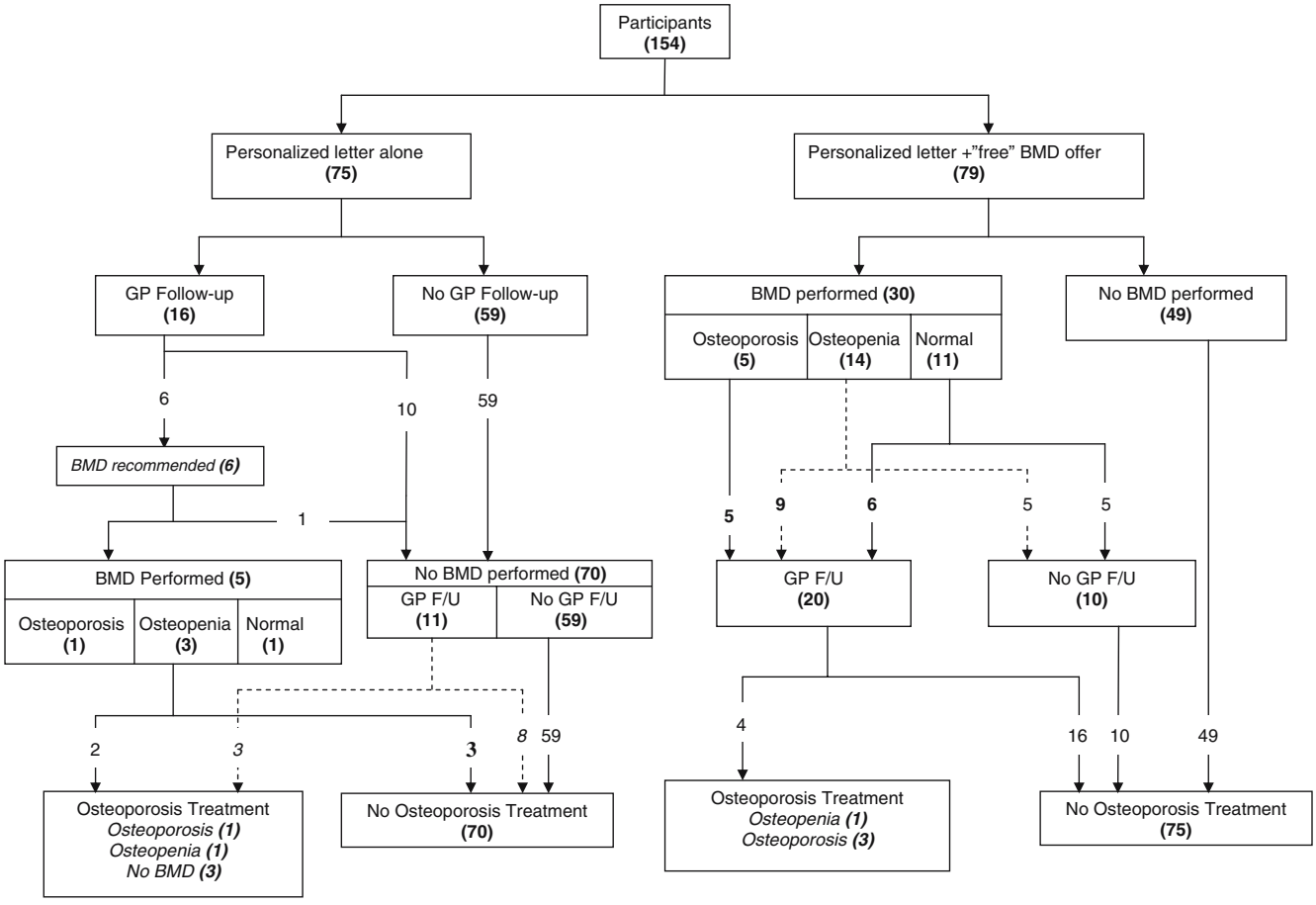

Fig. 2 Flow-chart of investigation and treatment for osteoporosis in 154 participants stratified by intervention groups

Table 3 Rates of osteoporosis treatment according to BMD results

T-score[a]	Minimal/ moderate[b]	No [c]Rx	Calcium + vitamin D only	BPX/SERM/ HRT[d]
≥−1.0	7/5	11	1	0
−1.1 to −2.5	13/4	12	3	2
<−2.5	6/0	1	1	4[e]

[a]T-score recorded was the lower of the spine (L_2–L_4) or total hip values
[b]Values recorded represent numbers of individuals with minimal or moderate trauma fracture
[c]Rx, the abbreviation for treatment
[d]BPX, Bisphosphonates; HRT, hormone replacement therapy
[e]Of the four people with osteoporosis, two took BPX for less than 2 months

minimal trauma fracture (90 vs. 67%; p=0.05) than the rest of the cohort.

The 39 participants who had a follow-up by their primary care physician after 3 months that was unrelated to the study intervention were also more likely to be female (79 vs. 55%; p=0.01), but they had the same age and fracture type distribution as those not investigated or treated.

Post-intervention management of osteoporosis

In the personalized letter group, only 16 (21%) participants contacted their primary care physician after receiving the letter (Fig. 2). Of these 16, the majority (n=14) had suffered minimal trauma fractures. Only 6 of the 14 with minimal trauma fractures were referred for BMD testing: one refused, two were subsequently recommended anti-resorptive therapy for osteoporosis and three were subsequently commenced on anti-resorptive therapy without investigation. Thus, the majority (83%) of those with minimal trauma and all of those with moderate trauma fractures from the personalized letter group were neither investigated nor treated for osteoporosis.

By contrast, in the group offered a BMD assessment 30 people (38%), of whom the majority (70%) suffered minimal trauma fractures, had a BMD test (Fig. 2). Of those with minimal trauma fractures (21), 15 (71%) had low bone density: five were osteoporotic (T-score: <−2.5 SD) and ten were osteopenic (T-score: <−1.0 and ≥−2.5). Of the nine moderate trauma fracture participants who had a BMD scan, 44% had osteopenia. However, only two-thirds of those who had a BMD scan contacted their GP after the test and of those who did, only three of the participants judged to be osteoporotic and one participant judged to be osteopenic were advised to commence anti-resorptive therapy, while simple vitamin D therapy was initiated in one participant with osteoporosis and in three with osteopenia (Table 3).

Although the BMD offer was associated with a significant increase in the rate of investigation for osteoporosis compared to letter alone (38 vs. 7%; p=0.01), there was no difference in the proportion of primary care physician follow-up in the personalized letter group compared to BMD offer group (21 vs. 25%; p=0.5). Only 23% of the whole randomized group sought attention from their primary care physician, and of these only a small proportion were recommended anti-resorptive treatment for osteoporosis. This was higher but not significantly so in the personalized letter vs. letter plus BMD offer group (31 vs. 20%; p=0.4). Five additional participants (one in the personalized letter and four in the BMD offer group) were recommended simple vitamin D therapy. Thus, the vast majority of the people (92%) did not receive any preventive therapy at any time.

Factors associated with primary care physician follow-up

Participants were more likely to have a primary care physician follow-up if they were female (p=0.02), were older than 50 years (p<0.0001), suffered a minimal trauma fracture (p=0.05) or perceived their fracture as osteoporotic (p=0.04) (Table 4). However, in multivariate analyses, the only independent predictors for having a primary care physician follow-up were an age older than 50 years (p=0.0003) and a perception of their fracture as osteoporotic (p=0.03) (Table 5). Interestingly, when analysed separately, men and women shared the same independent predictors for primary care physician follow-up. In those younger than 50 years of age (n=78), only one participant had a primary care physician follow-up.

For participants who had a BMD scan, a lower bone density (osteopenia and osteoporosis) was also a predictor for a primary care physician follow-up (p=0.025). However, this association was restricted only to the participants with minimal trauma fractures.

Table 4 Factors associated with primary care physician follow-up, investigation and treatment for osteoporosis – univariate analyses

Variables	GP follow-up[a]	Investigation[a]	Treatment[a]
Belief that fracture is osteoporotic	4.6 (1.6–13.0)	4.8 (1.7–13.6)	8.1 (1.9–34.0)
Age ≥50 years	6.3 (2.5–15.5)	2.8 (1.3–6.3)	–
Female sex	2.6 (1.2–5.9)	2.9 (1.3–6.8)	–
Minimal trauma	2.4 (1.0–5.7)	–	–
BMD performed	–	–	8.0 (1.2–33.9)

[a]Values are odds ratios and 95% confidence intervals (in parentheses)

Table 5 Factors associated with primary care physician follow-up, investigation and treatment for osteoporosis – multivariate analyses

Variables	GP follow-up[a]	Investigation[a]	Treatment[a]
Belief that fracture is osteoporotic	3.3 (1.1–10.0)	3.9 (1.3–11.3)	4.8 (1.0–22.4)
Age ≥50 years	5.5 (2.2–13.9)	–	–
Female sex	–	2.5 (1.0–5.9)	–
BMD performed	–	–	5.6 (1.2–25.7)

[a]Values are adjusted odds ratios and 95% confidence intervals (in parentheses)

Factors associated with management of osteoporosis

Participants were more likely to be investigated for osteoporosis if they were female (p=0.01), believed that their fracture was osteoporotic (p=0.003) and were older than 50 years (p=0.01). In the personalized letter alone group, a primary care physician follow-up was also a predictor (p=0.01). Independent factors associated with being investigated for osteoporosis were female sex (p=0.04) and the belief that the fracture was osteoporotic (p=0.01).

Treatment for osteoporosis clearly required primary care physician follow-up. The only independent factors associated with being treated for osteoporosis were the belief that the fracture was osteoporotic (p=0.04) and having a BMD test (p=0.03).

In the group of participants with minimal trauma fractures investigated for osteoporosis, those with a lower BMD test (osteopenia and osteoporosis) were more likely to be advised to start any form of preventive treatment for osteoporosis (p=0.025).

Discussion

This study evaluated the efficacy of a personalized patient information intervention strategy versus the same personalized information strategy plus the offer of a free BMD test in the management of osteoporosis in a cohort of minimal and moderate trauma fracture participants who had never been investigated or treated for osteoporosis. The results of this study demonstrated that the letter plus BMD offer intervention was associated with significantly more people being investigated for osteoporosis than the letter alone (38 vs. 7%; p=0.001). However, treatment uptake was exceedingly low in both groups (<6%), despite the fact that 66% of the newly investigated people had low bone density.

Even though one-half of all participants had a prior fracture and 86% had at least one major risk factor for osteoporosis highlighted in the personalized letter, the majority of participants (overall 70%) did not take any further steps towards osteoporosis risk assessment and management. Furthermore, even amongst those who contacted their physician, only a small proportion (25%) was recommended anti-resorptive therapy. This result clearly reflects the existence of both participant-related barriers to seeing their primary care physician and doctor-related barriers to initiating treatment even when appropriate.

Although the offer of a BMD test resulted in a higher proportion of participants having a BMD than those in the group receiving only the personalized letter going for a resultant GP follow-up (38 vs. 21%; p=0.025), this did not translate into a higher proportion of people who subsequently visited their primary care physician.

The belief that the fracture was osteoporotic increased by threefold the likelihood of all three management-related variables: having an osteoporosis-related primary care physician follow-up, being investigated and treated for osteoporosis. However, that was not a common belief. Even amongst people with minimal trauma fractures, 85% did not considered their fracture osteoporotic, and only 33% of those who had a low BMD believed their fracture could be osteoporotic. Hawker et al. [38] also reported that a perceived osteoporotic fracture was a predictor for both investigation and treatment, although this belief was not widely held.

Along with the belief that the fracture was not osteoporotic, a younger age (<50) was another participant-related barrier to seeking primary care physician consultation. Even though one-half of the participants younger than 50 years had had a prior fracture and 80% had at least one major risk factor for osteoporosis, only 15% of the younger participants took further steps towards osteoporosis assessment, the majority (92%) of this being uptake of a BMD scan. Interestingly, amongst those younger than 50 years who had a bone density test (n=11), half of the men and 29% of the women had low bone mass (T-score: ≤−1). Only one participant (8%) saw a primary care physician as a result of the personalized letter.

As in previous studies, men fared worse then women [12, 27, 29]. Not only were men less likely to respond to study intervention than women (p<0.001), but even among those who did, none were recommended anti-resorptive therapy, despite the fact that the majority of those investigated had low bone density (75%).

Despite the evidence that people with moderate trauma fractures may have low bone mass [13], these fractures are excluded in all post-fracture management studies. In the current study, moderate trauma fractures accounted for 33% of the total group (64/193). Although individuals with moderate trauma fractures had a similar high proportion of prior fracture, they were less likely to seek a primary care physician follow-up than those with minimal trauma fracture (p=0.01). Furthermore, 44% of those with moderate trauma fractures tested had osteopenia, but none were recommended preventive therapy or lifestyle modification by their physician.

In addition to the low rate of participant response to study intervention, an even more disappointing observation was that even among those who contacted their physician, the rates of investigation and treatment were low. The vast majority of people who contacted their primary care physician suffered minimal trauma fractures, had a high incidence of prior fracture (68%) and were older than 50 years, but only 25% were recommended specific osteoporosis therapy. These results highlight the urgent need for further exploration into doctor-related barriers to optimal osteoporosis management and also into the introduction of specific tools to address this problem.

To our knowledge, no other published studies have examined two different information-based interventions on fracture participants. A recent intervention study [38] consisting of patient education and a letter for patients to deliver to their primary care physician, similarly, did not demonstrate significant increase in rates of treatment compared to historical controls although primary care physician follow-up rates were higher than in the current study (65 vs. 21%). Majumdar et al. reported an intensive post-fracture intervention (physician reminders, treatment guidelines, patient education materials, plus telephone counseling session) that led to a 62% rate in osteoporosis investigation and a 40% rate of osteoporosis treatment 6 months post-fracture in a small cohort of 55 participants over 50 years treated for wrist fracture. The average age was greater in both these studies (66 and 73 years, respectively) than in the current study (51±20 years) which may explain the higher primary care physician follow-up rates as an association between older age and increased likelihood of primary care physician visits was demonstrated in the present study.

This study had some limitations. Firstly, there was no direct control group to examine the effect of the intervention compared to current standard of care. However, the results of the 3-month follow-up, which reflected the usual post-fracture care, showed that only 12% of the participants were investigated for osteoporosis and that only 6% were recommended anti-osteoporosis treatment.

Secondly, all of the information was obtained from participants with no addition information from other sources such as primary care physicians. Hence, the accuracy is subjected to recall bias. However, the final decision to start treatment rests ultimately with the participant and if anything, may be influenced by the "take-home" message from the primary care physician. Doctor-related barriers were not examined directly in this study. The investigator was not blinded for the allocation of intervention for the second follow-up. Finally, the inclusion of participants younger than 50 years may have lowered the impact of the study intervention on osteoporosis management, as only 15% in this group had either a primary care physician follow-up or a bone density test compared to over 40% in the group of participants older than 50 years. However, this result highlighted the lack of consideration of osteoporosis in these younger people.

The strengths of this study consisted of a detailed examination of all consecutive fracture subjects over a 15-month period in a major teaching hospital, with excellent participant retention rate (93%). Participants were randomized to study intervention and, therefore, all potential important confounders were equally distributed between the groups.

In summary, the results of this study demonstrated that an information-based intervention led to a mild increase in the number of people (23%) investigated for osteoporosis after a fracture, but had virtually no effect on treatment rates (6%). The offer of a free BMD was associated with significantly higher BMD uptake but did not affect treatment rate compared with an information-based letter alone. Participant-related barriers to osteoporosis intervention were found to be an age younger than 50 years and the belief that the fracture is not related to osteoporosis. Among the few participants who consulted their primary care physician, treatment was generally not recommended even when appropriate.

This study highlights significant barriers to osteoporosis investigation and treatment after a fracture and that these barriers lie both with the participants and their primary care physician. Given the current potential fracture burden on society, this area deserves urgent attention.

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