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Fall-related risk factors and osteoporosis in older women referred to an open access bone densitometry service

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Abstract

Objective: both falls and low bone density are important in the pathogenesis of osteoporotic fractures. Whilst bone density is routinely measured to assess fracture risk, little attention is given to the assessment of fall risk. In this study we have determined the prevalence and explored relationships between fall-related risk factors and osteoporosis in women referred to our open access bone densitometry service.
Design: cross-sectional study.
Setting: teaching hospital in south-west London, UK.
Subjects: older women referred for open access bone densitometry.
Measurements: bone densitometry by dual-energy X-ray absorptiometry and fall risk assessment (visual acuity, ability to do five stand-ups without arm use and ability to perform heel–toe walking).
Results: data for 558 women seen over an 18 month period were examined. Their mean age was 74.8 years (range 65–93). Fall risk and femoral neck (FN) osteoporosis increased with age, with fall-related risk factors being more prevalent than FN osteoporosis at each tertile of age. Women with both FN osteoporosis and fall-related risk factors ranged from 7% in the youngest tertile to 22% in the oldest tertile. In women with FN osteoporosis, increased fall risk was found in 37% in the youngest tertile, increasing to 63% in the oldest tertile.
Conclusions: fall-related risk factors are common in older women referred for open access bone densitometry. We recommend that both bone density and fall risk assessment, using simple screening tests for falls, are essential to determine fracture risk in older people referred for bone densitometry. Subsequent management to reduce fracture risk should be individualised for each patient.

Keywords: *fall-related risk factors, elderly, osteoporosis, older women, open access bone densitometry*

Introduction

Osteoporotic fractures are common and associated with increased morbidity and mortality (particularly hip fractures) [1, 2]. The pathogenesis of osteoporotic fractures is complex and thought to be due to a combination of osteoporosis and fall risk [3, 4]. Falling is particularly important for non-vertebral fractures such as hip fractures with over 90% of hip fractures being associated with a fall [5].

Bone densitometry is now routinely used to see if patients may have osteoporosis and drug treatment with bone active agents has been shown to reduce vertebral fractures and hip fractures [6, 7]. However, whilst falls are common and increasingly recognised as a leading cause of disability and mortality [7–9], little attention is given to assessment of fall risk when bone density is being measured in older individuals. This is important because if bone density alone is used to determine fracture risk, another potential major determinant of fracture, i.e. fall risk, is being overlooked. Indeed the importance of considering falls and osteoporosis management together in fracture risk assessment and prevention has been highlighted in England and Wales by the National Service Framework for Older People [9].

In a previous small study we showed that both bone density and fall risk could be easily measured in women referred for open access bone densitometry [10]. As part of routine clinical care we now measure both bone density and fall risk in older patients referred to our centre for open access bone densitometry and report this to the referring clinician. In this study we present data on a larger number of women, where we have explored the relationships between fall-related risk factors and osteoporosis in women referred to our open access bone densitometry service.

Patients and methods

The Osteoporosis Service at St George's Hospital provides an open access bone densitometry service for patients referred by family practitioners according to established referral criteria [11]. Our normal practice is that women older than 65 years who are referred for open access bone densitometry routinely undergo a fracture risk assessment consisting of brief history taking (by questionnaire), bone density measurements using dual-energy X-ray absorptiometry (DXA) and assessment for fall-related risk factors as previously described [10]. These tests of fall risk are performed by DXA technicians and take approximately 5 minutes to perform. For this report we identified community-dwelling women aged over 65 years who had a fracture risk assessment over an 18 month period.

DXA measurements were performed at the lumbar spine (LS) and femoral neck (FN) using a Lunar DPX device (Lunar Corp., Madison, WI, USA). Daily calibration measurements using an external phantom were performed and monitored for machine drift. No significant drift was noted during the study period. Precision was calculated by the method of Gluer *et al.* [12], and at our centre is 1.3% for the lumbar spine and 1.8% for the FN. Fall risk was assessed as previously described [10]. Briefly, we obtained a previous fall history, in particular whether a fall had occurred in the previous 12 months. We also measured: (i) binocular corrected visual acuity (VA) measured using a Snellen chart; (ii) ability to perform four tandem gait steps (heel–toe walking) graded as 1 = able to do four consecutive steps, 2 = unable to do four consecutive steps without stepping off the line or touching the examiner's arm, 3 = unable or unwilling to put feet in heel–toe position, and 4 = used a walking aid for most of the time; and (iii) ability to do stand-ups × 5 without arm use.

Data are presented as mean (SD) unless stated otherwise. One-way ANOVA was used to compare continuous variables between multiple groups and Chi-squared tests to compare proportions. A P value of < 0.05 was considered statistically significant. All analyses were performed using SPSS for Windows version 10 (Chicago, IL, USA).

Results

A total of 558 women over the age of 65 years were referred over the 18 months of evaluation. Of these, 214 women were taking a bisphosphonate, hormone replacement therapy, raloxifene or vitamin D. A further 77 women were taking steroids and 64 women had diseases that could predispose to falls and osteoporosis, such as rheumatoid arthritis. We defined the 203 remaining women who did not have these characteristics as group A and the 355 women who were on the treatments noted above or who had a secondary cause of falls and osteoporosis as group B.

The mean age of the total group of 558 women was 74.8 years (SD 7.1; range 65–93). A history of low trauma fracture was given by 260/558 (47%) of the women (distal radius 40%, hip 11%, vertebral 19%, humerus 3%, pelvis 2% and other sites 25%). A history of a fall in the previous 12 months was given by 209/558 (38%) of the women. More women in group A reported previous fracture: 159/203 (78%) compared with 100/355 (28%) for group B ($P < 0.01$); however, there were no differences in age or history of falls in the previous 12 months.

The women were divided into tertiles of age and the characteristics of the three groups are shown in Tables 1 and 2. Older women were shorter, tended to weigh less and spent

Table 1. Patient characteristics according to tertile of age

	Tertile 1 ($n = 186$)	Tertile 2 ($n = 186$)	Tertile 3 ($n = 186$)	P value
Age (years)	69.3 (2.2)	74.7 (1.5)	81.0 (3.3)	<0.0001
Height (m)	1.59 (0.06)	1.57 (0.09)	1.55 (0.07)	<0.0001
Weight (kg)	66.8 (12.1)	63.8 (13.3)	61.1 (11.3)	<0.0001
BMI	25.8 (4.4)	25.0 (4.4)	25.0 (4.7)	0.536
Mean number of hours on feet[a]	5.9 (3.2)	5.2 (3.0)	4.5 (2.7)	<0.0001

[a]Data available for group A only.

Table 2. Bone density according to tertile of age

	Tertile 1 ($n = 186$)	Tertile 2 ($n = 186$)	Tertile 3 ($n = 186$)	P value
LS BMD g/cm^2	1.03 (0.20)	0.98 (0.21)	0.96 (0.30)	0.016
LS T score	−1.42 (1.72)	−1.81 (1.74)	−1.74 (1.81)	0.091
LS Z score	0.41 (1.63)	0.17 (1.74)	0.44 (1.7)	0.223
FN BMD g/cm^2	0.78 (0.13)	0.73 (0.18)	0.72 (0.15)	0.000
FN T score	−1.65 (1.07)	−1.87 (1.51)	−2.10 (1.06)	0.002
FN Z score	−0.05 (1.00)	−0.20 (1.03)	−0.21 (0.85)	0.194

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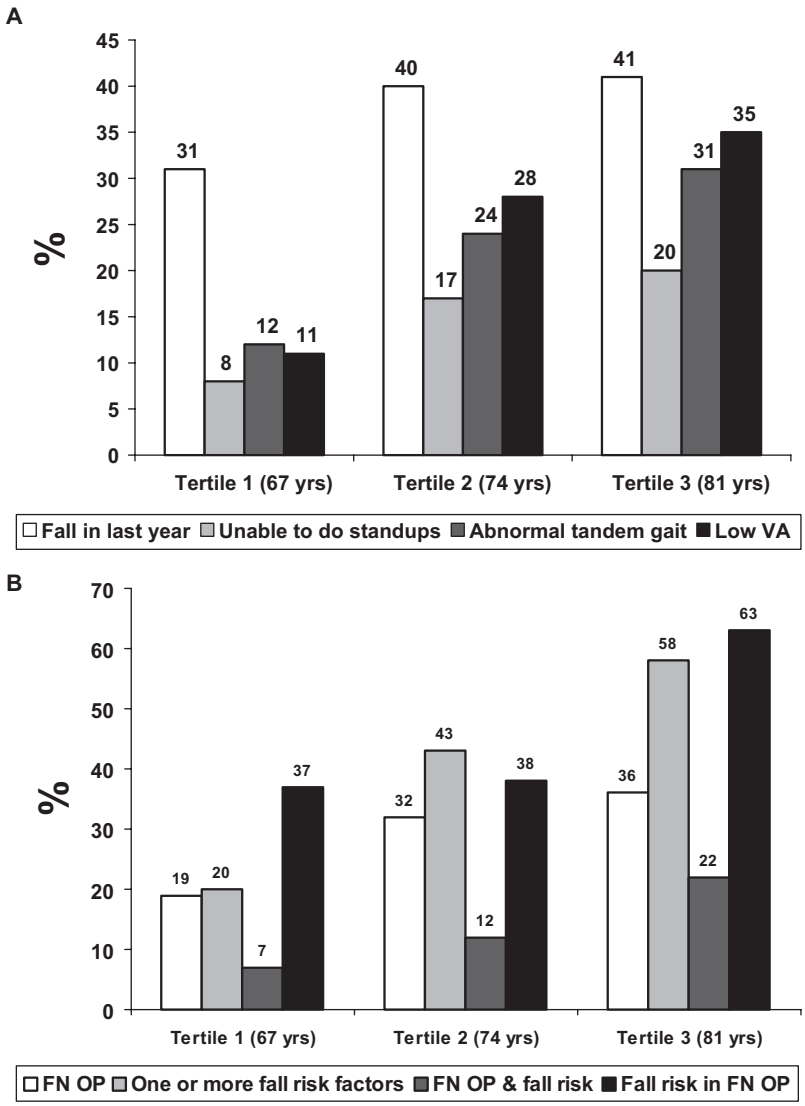

Figure 1. (A) Fall-related risk factors according to tertile of age. (B) Femoral neck osteoporosis and fall risk factors.

less time on their feet (data for group A only). As expected, bone mineral density (BMD) decreased with age (Table 2).

For the purposes of this study, increased fall risk was deemed to be present if VA was low (defined as <0.5 on a decimal scale), heel–toe walking was abnormal (defined as grade 3 or 4) or if there was inability to do five stand-ups. Based on these definitions, increased fall risk and a history of a fall in the previous 12 months according to tertile of age are shown in Figure 1A. The proportion of women with underperformance in the fall-related risk factors increased significantly with age. Thus, low VA increased from 11% in tertile 1 to 35% in tertile 3 ($P<0.001$), abnormal heel–toe walking from 12% in tertile 1 to 31% in tertile 3 ($P<0.01$) and inability to perform stand-ups from 8% in tertile 1 to 20% in tertile 3 ($P<0.01$). No differences were found between women in groups A and B in the performance of these tests.

Figure 1B shows the relationship between FN osteoporosis, fall risk and age. As expected, the proportion of women with FN osteoporosis increased with age (19% in tertile 1 to 36% in tertile 3; $P<0.05$). Also, the proportion of women with overall increased fall risk (defined for this analysis as one or more of the risk factors being abnormal) became more prevalent with age (20% in tertile 1 to 58% in tertile 3; $P<0.01$) (Table 2). Women who had both FN osteoporosis and overall increased fall risk ranged from 7% in tertile 1 to 22% in tertile 3 ($P<0.01$). In women with FN osteoporosis, overall increased fall risk was noted in 37% in tertile 1, increasing to 63% in tertile 3 ($P=0.20$).

Discussion

In this study we present data on fall-related risk factors and FN bone density in older women referred to an open access bone densitometry service. As expected we have demonstrated that both FN bone osteoporosis and fall-related risk factors become more common with increasing age. We also found that the fall-related risk factors that we

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measured were as common or, in older age groups, more common than FN osteoporosis (Figure 1B). In those women with FN osteoporosis, up to 63% had fall-related risk factors.

Whilst there are many risk factors for falls, the fall-related risk factors that we measured were chosen because they are predictive of falls associated with hip fracture (even after adjustment for BMD) [3, 4]. They are easy to measure with minimal training and take less than 5 minutes to perform. They also assess a variety of potentially remediable physiological parameters, i.e. eyesight (visual acuity), a test of lower limb musculoskeletal function (stand-ups) and a test of dynamic balance (heel–toe walking), which all deteriorated with age. In clinical practice, a variety of screening tools for fall risk are available and their use will vary according to local practice. If patients are found to have increased risk, more detailed fall risk assessment and subsequent management can be performed.

There is increasing evidence that interventions can reduce falls, although there is no convincing evidence that fractures can be prevented [7]. Interventions are usually multifactorial and individualised to improve risk factors present in that patient. Risk factors such as reduced VA and poor balance can be improved. Thus, in our previous smaller study we showed that significant improvements in VA could be achieved by correcting for refractive errors [10]. A recent population based study from Sweden also found that substantial improvements in VA could be achieved following correction for refractive error [13]. These observations suggest that regular eye testing and appropriate treatment thereafter are important in older women, particularly as poor visual function has strong associations with poor physical outcomes and disability [14]. Previous studies also suggest that balance can be improved by intervention [15], and recently there are data suggesting that calcium and vitamin D supplementation can reduce body sway [16] and falls [17].

The strengths of this study are the large numbers of women studied and the wide age range of these individuals. They were referred to an 'open access' service with the result that they were not pre-selected on grounds other than the referring clinician being concerned about increased fracture risk. Therefore, it is likely that these findings will have general applicability to women of this age. Limitations are that we only studied women so we cannot comment on whether men (who make up around 20% of hip fracture patients) will have similar findings. As we did not prospectively follow these women we were not able to validate the fall-related risk factors; however, this was not the primary aim of this study. We used a limited set of risk factors for falls, therefore it is possible that more sensitive measures such as body sway would have identified more women at risk of falling, although this could be associated with a reduction in specificity for injurious falls.

In conclusion we have shown that fall-related risk factors are common in older women referred for open access bone densitometry. These findings are important because whilst drugs to treat older women with FN osteoporosis are being increasingly used, relatively little attention is given to reducing the risk of falls.

We recommend that both bone density and fall risk assessment, using simple screening tests for falls, are essential to determine fracture risk in older people. Subsequent management to reduce fracture risk should be individualised for each patient.

Key points

- Fall-related risk factors are common in women referred for bone densitometry.
- Approximately 60% of older women with FN osteoporosis have fall-related risk factors.
- Both bone density and fall risk assessment, using simple screening tests for falls, are essential to determine fracture risk in older people referred for bone densitometry.

Conflict of interest

The authors have no conflict of interest to declare.

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