Factors influencing diagnosis and treatment of osteoporosis after a fragility fracture among postmenopausal women in Asian countries: a retrospective study

Annie W Kung, Tao Fan, Ling Xu, Wei B Xia, Il Hyung Park, Hak Sun Kim, Siew Pheng Chan, Joon Kiong Lee, Leonard Koh, Yung Kuei Soong, Suppasin Soontrapa, Thawee Songpatanasilp, Thana Turajane, Marc Yates and Shuvayu Sen

Abstract

Background: A vast amount of literature describes the incidence of fracture as a risk for recurrent osteoporotic fractures in western and Asian countries. Osteoporosis evaluation and treatment after a low-trauma fracture, however, has not been well characterized in postmenopausal women in Asia. The purpose of this study was to characterize patient and health system characteristics associated with the diagnosis and management of osteoporosis among postmenopausal women hospitalized with a fragility fracture in Asia.

Methods: Patient surveys and medical charts of postmenopausal women (N=1,122) discharged after a fragility hip fracture from treatment centers in mainland China, Hong Kong, Singapore, South Korea, Malaysia, Taiwan, and Thailand between July 1, 2006 and June 30, 2007 were reviewed for bone mineral density (BMD) measurement, osteoporosis diagnosis, and osteoporosis treatment.

Results: The mean (SD) age was 72.9 (11.5) years. A BMD measurement was reported by 28.2% of patients, 51.5% were informed that they had osteoporosis, and 33.0% received prescription medications for osteoporosis in the 6 months after discharge. Using multivariate logistic regression analyses, prior history of fracture decreased the odds of a BMD measurement (OR 0.63, 95% CI 0.45-0.88). Having a BMD measurement increased the odds of osteoporosis diagnosis (OR 10.1, 95% CI 6.36-16.0), as did having health insurance (OR 4.95, 95% CI 1.51-16.21 for private insurance with partial self-payment relative to 100% self-payment). A history of fracture was not independently associated with an osteoporosis diagnosis (OR 0.80, 95% CI 0.56-1.15). Younger age reduced the odds of receiving medication for osteoporosis (OR 0.59, 95% CI 0.36-0.96 relative to age ≥65), while having a BMD measurement increased the odds (OR 1.79, 95% CI 1.23-2.61).

Conclusions: Osteoporosis diagnosis and treatment in Asian countries were driven by BMD measurement but not by fracture history. Future efforts should emphasize education of general practitioners and patients about the importance of fracture.

Keywords: Osteoporosis, Bone density, Female, Fractures, Asia
Background
The prevalence of osteoporosis increases markedly after age 50 in postmenopausal women in Asia [1-3]. In Korea the prevalence of osteoporosis measured by bone mineral density (BMD) scanning of the lumbar spine has been reported to be 31% in postmenopausal women 45–64 years, 53% in those 65–74 years, and 69% in those ≥75 years [3]. Similar observations have been made in Taiwan [1].

A definitive diagnosis of osteoporosis in asymptomatic women is achieved via BMD measurement but, because of the relatively high cost of these measurements, a case-finding strategy is recommended [4]. A simple risk index based only on age and body weight can be used to screen for osteoporosis in Asian postmenopausal women prior to BMD measurement [5-8]. Since prior fracture is a well-documented risk factor for a future non-vertebral osteoporotic fracture in postmenopausal women in western and Asian countries [9-11], therefore, it is recommended that after a fragility fracture all postmenopausal women should be evaluated for osteoporosis [12]. Recent studies in western countries indicate that rates of treatment with medications for osteoporosis after a fracture vary widely. In a study in Italy 78% of patients received a medication for osteoporosis after a hip fracture [13]. Conversely, in the Netherlands only 19% of women age ≥50 years were treated with medications for osteoporosis in the year after a low-trauma fracture [14] and in Belgium only 6% of postmenopausal women received a bisphosphonate or hormone therapy after a hip fracture [15].

Little is known, however, about osteoporosis evaluation and treatment after a low-trauma fracture in countries in Asia. The objective of this study was to evaluate the diagnosis and treatment of osteoporosis among postmenopausal women after hospitalization for a fragility fracture in a selection of Asian countries.

Methods
Study design and patient sample
This was a patient survey and medical chart review carried out at multiple centers in six Asian countries including mainland China, Hong Kong, Singapore, South Korea, Malaysia, Taiwan, and Thailand. Women who were hospitalized due to fragility fracture of the hip between July 1st, 2006 and June 30th, 2007 (the case identification period) were identified using discharge records of participating hospitals. A random sample of these patients was selected for inclusion in the study. Patients were included if they had been hospitalized because of non-traumatic hip fracture (defined as resulting from a fall from standing height), were postmenopausal, and were able to participate independently in an interview. The index fracture, i.e., the fracture qualifying the subject for enrollment, was identified by reviewing hospitalization, emergency room or outpatient visit records for ICD-9/10 diagnosis codes 820.0, 820.2, or 820.8. Approval was obtained from participating hospital IRB committees; informed consent was provided by all patients.

Data collection
Medical chart review
Medical charts were reviewed during hospitalization to obtain data on BMD (T-score for spine, femoral neck, or total hip), height and weight, comorbidities, and medications prescribed for osteoporosis.

Patient questionnaire
Face-to-face and telephone interviews were conducted with patients to collect data about an osteoporosis diagnosis, BMD measurement, and osteoporosis treatment in the 6-month period following hospitalization for a fragility fracture.

Table 1 Patient characteristics

| Age category (years) | n  | N(%)  |
|----------------------|----|-------|
| <50                  | 41 | 1,122 | 3.7 |
| 50-64                | 188| 1,122 | 16.8|
| ≥65                  | 893| 1,122 | 79.5|
| BMD measurement      | 316| 837   | 28.2|
| Been told had osteoporosis | 579| 1,122 | 51.5|
| Prescription drug for osteoporosis | 370| 1,122 | 33.0|
| History of fragility fracture | 174| 1,081 | 16.1|
| Falls in past 12 months | 278| 1,051 | 24.8|
| Family history of osteoporosis | 70 | 777   | 6.2 |
| Family history of fracture | 113| 872   | 10.1|
| Corticosteroid use    | 41 | 972   | 3.7 |

Comorbidities

| Arthritis            | 103| 889   | 9.2 |
| Hypertension         | 593| 1,048 | 52.9|
| Diabetes             | 329| 975   | 29.3|
| Stroke               | 125| 920   | 11.1|
| Depression           | 36 | 894   | 3.2 |
| Parkinson’s disease  | 32 | 892   | 2.9 |

Type of payment

| 100% self pay        | 260| 1,069 | 23.2|
| Partial self pay with social insurance | 458| 1,069 | 40.8|
| Partial self pay with private insurance  | 25 | 1,069 | 2.2 |
| 100% paid by social insurance | 100| 1,069 | 8.9 |
| 100% paid by private insurance | 23 | 1,069 | 2.0 |
| Hospital treatment free of charge          | 41 | 1,069 | 3.7 |
| Others                            | 162| 1,069 | 14.4|

*Number of “yes” or “no” responses. Patients who did not respond to questions were treated as missing values and not included.

bAs a percent of 1,122.
fragility fracture. Patients were asked “Have you ever been told that you have osteoporosis?” If they answered “yes”, they were asked when they were told they had osteoporosis (in relation to the index fracture). They were also asked whether and when they had a BMD measurement for osteoporosis and what reimbursement, if any, they received for their hospital stay. Response options were either items in a checklist or “yes”, “no”, or “don’t know”. Questions about their post-fracture follow-up included whether they were advised to take prescription drugs or dietary supplements in the 6 month period after hospitalization for the index fracture, whether they were still being treated by a physician for osteoporosis, and the specialty of the physician. Other items recorded their demographic and, clinical characteristics and their fracture history prior to the index fracture.

**Statistical analysis**

The main outcome variables were binary variables (yes/no) for a BMD measurement, an osteoporosis diagnosis, and receipt of an osteoporosis medication. The associations between patient characteristics (age category, fracture history, and payment type) and the outcome variables were examined in univariate analyses; P values were computed using Fisher’s exact test. Logistic regression analyses were applied to identify significant factors independently associated with the outcome variables BMD measurement, osteoporosis diagnosis and receipt of medications. For the model with BMD screening as outcome variable, independent variables were age category, history of fracture, and payment type. Only patients who answered “yes” or “no” were included in the model with a BMD measurement as dependent variable; patients who responded “don’t know” were excluded. For the model with osteoporosis diagnosis as outcome variable, independent variables included were age category, fracture history, BMD measurement and type of payment. For the model with receipt of osteoporosis medications as outcome variable, independent variables included were age category, fracture history, fracture diagnosis timing, BMD measurement and type of payment.

A subgroup analysis assessed the impact of lower BMD on osteoporosis diagnosis and receipt of osteoporosis medications among patients whose BMD values were recorded. BMD values were expressed as a categorical variable, and Fisher’s exact test was applied. BMD of the total spine, femoral neck, or total hip was used in the stated order as available. A logistic regression model was applied to this patient subset, with osteoporosis treatment as dependent variable and the following independent variables: age category, a history of fracture, and T score category. Percent of patients using osteoporosis medications were calculated.

**Table 2 Rates of BMD measurement, osteoporosis diagnosis, and osteoporosis medication**

|                        | BMD measurement (N=1,122) | Osteoporosis diagnosis (N=1,122) | Osteoporosis medication (N=1,122) |
|------------------------|---------------------------|----------------------------------|----------------------------------|
|                        | %                         | P valuea                         | %                                | P valuea | %                                | P valuea |
| Total                  | 28.2                      | <0.001                           | 51.5                             | 0.009    | 33.0                             |          |
| Age                    |                           |                                  |                                  |          |                                  |          |
| <50                   | 9.8                       | <0.001                           | 17.1                             | 0.0      | 0.0                              |          |
| 50-64                  | 30.3                      | 0.0                              | 51.6                             | 0.0      | 22.3                             |          |
| ≥65                   | 28.7                      |                                  | 53.1                             | 0.0      | 35.5                             |          |
| Fracture history       |                           | <0.001                           | <0.001                           | 0.53     |                                  |          |
| Yes (n=174)           | 38.5                      |                                  | 65.5                             | 36.8     |                                  |          |
| No (n=907)            | 26.9                      |                                  | 48.6                             | 32.0     |                                  |          |
| Payment type           |                           | <0.001                           | <0.001                           |          | <0.001                           |          |
| 100% self pay         | 19.7                      |                                  | 10.9                             | 23.2     |                                  |          |
| Partial self pay with social insurance | 25.9 |                                  | 21.2                             | 40.8     |                                  |          |
| Partial self pay with private insurance | 1.4 |                                  | 1.4                              | 2.2      |                                  |          |
| 100% paid by social insurance | 7.3 |                                  | 3.3                              | 8.9      |                                  |          |
| 100% paid by private insurance | 1.3 |                                  | 1.0                              | 2.0      |                                  |          |
| Hospital treatment free of charge | 3.4 |                                  | 2.5                              | 3.7      |                                  |          |
| Others                | 11.2                      |                                  | 9.6                              | 14.4     |                                  |          |
| Unknown insurance     | 29.7                      |                                  | 1.6                              | 4.7      |                                  |          |

aP-value for Fisher’s exact test.
Results and discussion

Patient sample
Selection of sample
A total of 1,148 post-menopausal women hospitalized due to fragility fractures met the inclusion criteria and were enrolled in the study. Of these, 26 (2.3%) patients did not answer the question about an osteoporosis diagnosis and were excluded from the analysis. The data analysis was applied to the remaining 1,122 subjects.

Patient characteristics
Patient characteristics are presented in Table 1. The mean (SD) age was 72.9 (11.5) years. A history of fragility fracture prior to the hip fracture was recorded in 16.1% of patients, 52.9% had hypertension and 29.3% had diabetes. The most frequent types of payment were "partial self pay with social insurance" (40.8%) and "100% self pay" (23.2%).

BMD measurement
A BMD measurement prior to hip fracture was reported by 28.2% of the 837 patients who answered "yes" or "no" to the BMD measurement question (Table 1). Age category, a history of fracture, and type of payment were associated with having had a BMD measurement in the

Table 3 Logistic regression analyses

| BMD measurement (N=837) | Osteoporosis diagnosis | Osteoporosis medication |
|-------------------------|------------------------|-------------------------|
| Age                     | OR (95% CI)            | OR (95% CI)             | OR (95% CI)             |
| 20-49                   | 1.38 (0.35-5.51)       | 0.6 (0.18-2.00)         | N/A                     |
| 50-64                   | 1.36 (0.91-2.05)       | 1.19 (0.77-1.84)        | 0.59 (0.36-0.96)        |
| 65+ Reference           | Reference              | Reference               | Reference               |
| Fracture history        |                        |                         |                         |
| Yes                     | 0.63 (0.45-0.88)       | 0.80 (0.56-1.15)        | 1.05 (0.71-1.54)        |
| No                      | Reference              | Reference               | Reference               |
| Fracture diagnosis timing |                       |                         |                         |
| Before index fracture   | N/A                    | N/A                     | 0.99 (0.64-1.52)        |
| During index fracture   | N/A                    | N/A                     | 1.38 (0.87-2.18)        |
| After index fracture    | N/A                    | N/A                     | Reference               |
| Unknown                 | N/A                    | N/A                     | 0.28 (0.05-1.47)        |
| A BMD measurement       |                        |                         |                         |
| Yes                     | N/A                    | 10.1 (6.36-16.0)        | 1.79 (1.23-2.61)        |
| Unknown                 | N/A                    | 0.06 (0.03-0.10)        | 1.48 (0.59-3.74)        |
| No                      | N/A                    | Reference               | Reference               |
| Type of payment         |                        |                         |                         |
| 100% private insurance  | 8.19 (2.63-25.58)      | 0.72 (0.20-2.54)        | 2.03 (0.54-7.66)        |
| 100% social insurance   | 1.96 (1.09-3.50)       | 0.47 (0.27-0.84)        | 0.18 (0.07-0.51)        |
| Other type of insurance | 5.08 (3.11-8.30)       | 2.48 (1.45-4.25)        | 2.45 (1.40-4.29)        |
| Unknown insurance       | 1.33 (0.62-2.83)       | 0.39 (0.19-0.80)        | 1.05 (0.38-2.92)        |
| Free hospital, government pay | 4.13 (2.00-8.54) | 1.31 (0.57-3.03)        | 1.56 (0.66-3.70)        |
| Partial self with private insurance | 3.43 (1.19-9.86) | 4.95 (1.51-16.21) | 0.49 (0.15-1.59) |
| Partial self with social insurance | 3.94 (2.61-5.95) | 1.89 (1.28-2.81) | 0.72 (0.45-1.15) |
| 100% self pay Reference | Reference              | Reference               | Reference               |

N/A, not applicable.

Table 4 Osteoporosis diagnosis and treatment among the subgroup of patients with a BMD measurement

| T score | n (%) | Osteoporosis diagnosis (%) | Osteoporosis medication (%) |
|---------|-------|---------------------------|-----------------------------|
| Greater than −1 | 23 (9.0) | 60.9 | 43.8 |
| −1 to −2.5 | 103 (40.2) | 70.0 | 59.2 |
| −2.5 to −3 | 39 (15.2) | 92.3 | 61.5 |
| Lower than −3 | 91 (35.6) | 82.4 | 78.0 |
| Total | 256 (100) | 77.0 | 64.8 |

*P=0.003 (Fisher’s exact test).
univariate analysis (Table 2). In the multivariate regression model (Table 3), the variables independently associated with having had a BMD measurement were fracture history (a history of fracture reduced the odds of a BMD measurement) and type of insurance (compared to 100% self pay, all specified types of insurance increased the odds of having a BMD measurement), but not age category.

Table 5 Osteoporosis treatments

|                      | (%) (N=1,122) |
|----------------------|--------------|
| **Prescription medications for osteoporosis** |              |
| Any prescription drugs | (33.0)       |
| Any bisphosphonate    | (26.0)       |
| Any anti-resorptive   | (31.0)       |
| Alendronate           | (16.5)       |
| Risedronate           | (6.9)        |
| Calcitonin            | (4.8)        |
| Pamidronate           | (4.2)        |
| Raloxifene            | (2.2)        |
| Others                | (2.9)        |
| **Supplement use**    |              |
| Any supplement        | (50.3)       |
| Calcium               | (32.1)       |
| Vitamin D             | (23.8)       |
| Multi-vitamin         | (9.1)        |

*Medications used by >2.0% of patients are listed.

Osteoporosis diagnosis

Over half of the patients (51.5%) reported that they had been told they had osteoporosis (Table 1). Older age category, a history of fracture, and type of payment were significantly associated with an osteoporosis diagnosis (Table 2). In logistic regression analysis having had a BMD measurement and type of payment were associated with an osteoporosis diagnosis: compared to individuals with 100% self pay, the odds of an osteoporosis diagnosis were decreased among patients with 100% social insurance and increased among patients with partial self payment with private or social insurance, and among those with “other type of insurance” (Table 3). However, a fracture history was not significantly associated with an osteoporosis diagnosis. T scores were available for 256 patients. A lower T score was more likely associated with an osteoporosis diagnosis in the univariate analysis (Table 4).

Osteoporosis treatment

Only 33.0% of patients received prescription medications for osteoporosis in the 6 months after the index fracture (Table 1). A bisphosphonate was prescribed for 26% of patients, representing 79% of prescription medications for osteoporosis (Table 5). Calcitonin was the most frequent non-bisphosphonate therapy, used by 4.8% of patients. Half of the patients (50.3%) used dietary supplements (Table 5).

![Figure 1 BMD measurement, osteoporosis diagnosis and treatment, by country. P<0.001 (Fisher’s exact test).](image-url)
Patient age category and payment type were significantly associated with treatment for osteoporosis in univariate analyses (Table 2). Age category, having had a BMD measurement, fracture history and type of payment were associated with osteoporosis treatment in multivariate logistic analysis (Table 3). Younger age category (50–64 years) reduced the odds of receiving medication for osteoporosis, while having had a BMD measurement increased the odds of treatment. The odds of treatment were reduced by having 100% social insurance and increased by “other type of insurance” when compared to 100% self-pay. A history of fracture was not associated with receiving medications for osteoporosis. A more negative T score was associated with osteoporosis, obviating the need for a BMD test. A recurrent fracture after the index fracture was experienced by 9% of the patients in this study. A history of prior fracture was a significant independent predictor of a recurrent fracture (OR 1.67, 95% CI 1.02-2.72), while other factors (age, an osteoporosis diagnosis, a BMD measurement) were not significantly predictive.

Summary
In this study, an average of 33.0% of patients received a prescription medication for osteoporosis in the 6 months after the index fracture, though this varied from 6.5% in mainland China to 63.5% in Thailand. These rates are comparable or better than recent practice recorded in Western countries. In a 2003–04 UK study of patients (97% women) after a fracture of the distal radius, 8.5% were referred for BMD scanning, calcium and vitamin D was prescribed to 22%, and bisphosphonates to 9% [16]. In a 2006 study set in Sweden, management of patients post fracture depended on the results of a BMD scan [17]. In the three years after the fracture, antiresorptive medicines (excluding calcium-vitamin D) had been received by two thirds of osteoporotic, one sixth of osteopenic, and none of the patients with normal BMD [17]. There is little recent data for the United States, and most studies of medical practice after low-trauma or hip fracture relate to small single-center studies in the 1990s. Among these US studies the median rate of prescribed medicines for osteoporosis after a fracture was 24% (range 5-60%) [18-24].

Conclusions
Even after experiencing a fragility fracture, 48.5% of Asian postmenopausal women reported that they had not been told that they had osteoporosis and only 33.0% were receiving prescription medications for osteoporosis. A history of fracture did not increase the odds of an osteoporosis diagnosis or treatment, indicating that both patients and GPs should be educated about the importance of fractures in the evaluation of osteoporosis.

Abbreviations
AK: A.W. Kung; AM: A. Modi; BMD: Bone mineral density; GPs: General practitioners; HK: H.S. Kim; ICD: International Statistical Classification of Diseases and Related Health Problems; IP: L.H. Park; IRB: Institutional review board; JL: J.K. Lee; LK: L. Koh; LX: L. Xu; MY: M. Yates; SC: S.P. Chan; SS: S. Soontrapa; SSS: S. Sen; TF: T. Fan; TS: T. Songpatanasilp; TT: T. Turajane; UK: United Kingdom; WX: W.B. Xia; YS: Y.K. Soong.

Competing interests
TF, AM, and SSS are employees of Merck & Co., Inc. The other authors have no conflicts of interest to declare.

Authors’ contributions
AK, TF, and LX contributed to study design, manuscript writing, patient recruitment, questionnaire development, and statistical analysis. WX, IP, HK, SC, JL, LX, YS, SS, TS, and TT contributed to study design, manuscript writing, patient recruitment, and questionnaire development. MY contributed to...
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