available at http://ajws.elsevier.com/tcmj

Tzu Chi Medical Journal

Original Article

# Concordance of a Self Assessment Tool and Measurement of Bone Mineral Density in Identifying the Risk of Osteoporosis in Elderly Taiwanese Women

*Yin-Ming Li*[1,2]*

[1]*Department of Family Medicine, Buddhist Tzu Chi General Hospital, Hualien, Taiwan*
[2]*Department of Public Health, Tzu Chi University, Hualien, Taiwan*

**Article info**

*Article history:*
Received: October 18, 2007
Revised: November 13, 2007
Accepted: January 15, 2008

*Keywords:*
Osteoporosis
Postmenopausal women
Self assessment tool
Validity

**Abstract**

***Objective:*** Osteoporosis is the most common generalized bone disease related to aging. The Osteoporosis Self-Assessment Tool for Asians (OSTA) risk index was developed to screen postmenopausal Asian women to identify women who should be evaluated with bone densitometry. In Taiwan, there is no report of the validity of the OSTA with dual energy X-ray absorptiometry (DXA) as a reference. In this study, we assessed the validity of the OSTA risk index and discuss its applications, using DXA of the lumbar spine as the gold standard.

***Patients and Methods:*** Healthy subjects, aged 30–85 years, who were receiving a health check-up at a teaching hospital in eastern Taiwan were invited to participate in this study. All subjects gave their consent to analyze their data. A self-administered questionnaire was used to assess their demographic characteristics, and reproductive and medical histories. Bone mineral density of the posterior-anterior lumbar spine was measured by DXA, and a diagnosis of osteoporosis was made according to World Health Organization criteria. The sensitivity and specificity and their 95% confidence intervals (CIs) were calculated for the dichotomized OSTA risk index.

***Results:*** This cohort consisted of 498 postmenopausal Taiwanese women, with a mean age of 60.3±7.6 years and a mean weight of 57.9±8.9 kg. Spinal DXA revealed that 35.9% were osteoporotic (with a T-score of ≤−2.5). The OSTA risk index at the standard cut-off point of ≤−1 had a sensitivity of 57.0% (95% CI: 52.7, 61.3) and a specificity of 69.3% (95% CI: 65.3, 73.4). Among women aged 60–70 years, the sensitivity, specificity, and accuracy of the OSTA risk index were 77.1% (95% CI: 63.7, 76.9), 49.2% (95% CI: 42.0, 56.4), and 64.9% (95% CI: 60.7, 69.8), respectively.

***Conclusion:*** The OSTA risk index is a convenient but not a very sensitive tool to help target high-risk women aged 60–70 years for DXA testing. Clinical risk factors and the OSTA risk index should be combined to assess women aged ≤60 years. Further study of the validity of the OSTA risk index among elderly women with a larger sample size in different populations should be conducted with spinal and femur neck DXA testing as references. {*Tzu Chi Med J* 2008;20(3):206–212}

*Corresponding author. Department of Family Medicine, Buddhist Tzu Chi General Hospital, 707, Section 3, Chung-Yang Road, Hualien, Taiwan.
E-mail address: yinming@mail.tcu.edu.tw

## 1. Introduction

Osteoporosis, a complex and costly disease, is a growing global health concern [1]. This disease is silent until the complication of a fracture occurs. Osteoporosis-related factures lead to significant morbidity and mortality [2–4] and poor functional outcomes [4,5]. Hence, early prevention of bone loss, especially before the first fracture has occurred, is important in delaying the progress of the disease.

The Osteoporosis Self-Assessment Tool for Asians (OSTA) is a recently developed measurement that is used to identify Asian women at increased risk of osteoporosis. This risk index was developed from postmenopausal women in eight different Asian regions by assessing multiple clinical risk factors associated with bone loss and osteoporosis and ultimately yielding an index based only on age and body weight [6]. Validation of the OSTA index for screening populations at higher risk of osteoporosis has been assessed in some Asian countries [7–10]. In Taiwan, correlating the OSTA screening tool with a quantitative ultrasound of the calcaneus has been assessed. The sensitivity and specificity of the index were 84.0% and 61.0%, respectively. As the age of the population increases, there is an increasing false-negative rate [11]. Most studies found that the OSTA index can be used as a tool to identify women at high risk so that they can be further assessed. In Taiwan, there is no report of the validity of the OSTA index with DXA as a reference. In this study, we evaluated the usefulness of the OSTA index and discuss its applications among postmenopausal women, with DXA of the lumbar spine used as the gold standard.

## 2. Patients and methods

This was a prospective study carried out in 2004 to 2005 at a teaching hospital in eastern Taiwan. Healthy subjects, aged 30–85 years, who were receiving a health check-up were invited to participate in this study. All subjects gave their consent for us to analyze their data, and the project was approved by the Protection of Human Subjects Institutional Review Board of Tzu Chi University and Hospital. In total, 1368 participants enrolled in this study, and 32 (2.4%) subjects were excluded from the study because they had a history or evidence of metabolic bone disorders, were taking medication such as thyroid hormone or bisphosphonates, or had a history of lumbar spine, femoral or radius fracture. In this paper, only data of postmenopausal women ($n$=498) were used for analyses.

### 2.1. Data collection

Self-administered questionnaires were used to assess the following parameters: education level, marital status, occupation, whether or not a person was a vegetarian, smoking, alcohol consumption, physical activity, number of childbirths, age at menarche, years since menopause, and operations on the ovaries. The medical history (i.e., asthma, hypertension, diabetes, thyroid problems, etc.) and medications (the use of oral steroids and estrogen) were also assessed. The height and weight of subjects were measured by a nurse. The weight was measured without shoes in light indoor clothing, using a calibrated digital scale. The height was measured using a calibrated stadiometer.

Bone mineral density (BMD) of the posterior-anterior lumbar spine was measured by dual energy X-ray absorptiometry (DXA) using a Hologic QDR 4500W densitometer (Hologic Inc., Waltham, MA, USA). The coefficient of variation of our machine was 1%. The mean value for bone density of the lumbar spine (L1–L4) was labeled as the subject's $BMD_L$. The assessment of $BMD_L$ was also categorized with the T-score (with a normal young adult as the reference) into three groups of T-scores of $\geq -1.0$ (defined as *normal*), $<-1.0$ (*low osteopenic*), and $\leq -2.5$ (*osteoporotic*) according to World Health Organization (WHO) criteria [1]. The OSTA risk index was calculated for each subject using her current age (in years) and weight (in kilograms) as $0.2\times(\text{weight}-\text{age})$; the value was truncated to yield an integer value. Risk categories were divided into *high risk* (OSTA$\leq -1$) and *low risk* (OSTA$>-1$) [6].

### 2.2. Statistical analysis

Comparisons of the age, body weight, height, and body mass index (BMI) between women with and without osteoporosis were made. The sensitivity and specificity were calculated for the dichotomized OSTA risk index, with their 95% confidence intervals (CIs) based on a binominal distribution. Pearson's $\chi^2$ test or unpaired Student's $t$ test was used to evaluate the significance of differences when appropriate. A four-fold table was applied to calculate the sensitivity, specificity, and accuracy of the OSTA index compared with the T-score cut-off values of the $BMD_L$ by DXA. Receiver operating characteristic (ROC) curves were constructed, and the area under the curve (AUC) as well as the 95% CIs were estimated.

## 3. Results

### 3.1. Characteristics of participants

In total, 498 women participated. Their mean age was $60.3\pm7.6$ years (range, 42–85 years), and their mean body weight was $57.9\pm8.9$ kg. Mean age at menopause was $51.4\pm6.2$ years, but 11.9% of them experienced menopause before the age of 45 years, and

**Table 1 — Characteristics of the 498 postmenopausal women***

| | Osteoporosis | | | $p^{\dagger}$ |
|---|---|---|---|---|
| | All ($N$=498) | Yes ($n$=179) | No ($n$=319) | |
| Age (yr) | 60.3±7.6 | 63.0±7.4 | 58.8±7.3 | <0.01 |
| Body weight (kg) | 57.9±8.9 | 55.5±8.5 | 59.2±8.8 | <0.01 |
| Height (cm) | 153.6±8.5 | 152.9±12.3 | 154.5±4.9 | <0.01 |
| Body mass index (kg/m$^2$) | 24.5±3.3 | 23.9±3.1 | 24.8±3.4 | <0.01 |
| Bone mineral density | 0.830±0.2 | 0.682±0.1 | 0.910±0.1 | <0.01 |
| OSTA | –0.49±2.3 | –1.5±2.2 | 0.08±2.3 | <0.01 |
| T-score | –1.79±1.6 | –3.3±0.6 | –0.9±1.3 | <0.01 |
| Years since menopause | 10.0±7.9 | 12.0±8.3 | 8.9±7.4 | <0.01 |
| Lifestyle | | | | |
| Vegetarian diet | 23.9 | 18.7 | 26.8 | <0.05 |
| Currently taking estrogen | 12.7 | 8.4 | 15.1 | <0.05 |
| Currently taking calcium supplements | 38.2 | 39.1 | 37.6 | NS |
| Exercise≥3 times/wk | 59.6 | 56.0 | 61.7 | NS |

*Data presented as mean±standard deviation or %; $^{\dagger}\chi^2$/Fisher's exact test or $t$ test. OSTA = Osteoporosis Self-Assessment Tool for Asians; NS = non-significant.

15.3% weighed less than 50 kg. Only eight women were currently taking steroids, and 23.9% were vegetarian. About 40% reported currently taking calcium supplements, and 12.7% had once or were currently receiving estrogen therapy (Table 1). Half of them self-reported engaging in no regular exercise, and only 12.8% reported exercising daily. None were current smokers. Fourteen women reported occasionally consuming alcohol.

### 3.2. BMD

The mean T-score of the $BMD_L$ was –1.8±1.6 (range, –6.1–4.24; median, –2.0). The $BMD_L$ measurement revealed that 35.9% (95% CI: 31.7, 40.1) of the postmenopausal women had osteoporosis and 42.0% (95% CI: 35.7, 44.3) had osteopenia. The results of the $BMD_L$ measurement among different age groups are shown in Fig. 1. Compared with the non-osteoporotic group, women with osteoporosis had a significantly higher mean age, lower body weight, shorter height, and lower mean OSTA index ($p$ value for all comparisons <0.05). The average time interval since menopause was 12 years; a higher proportion of them were currently taking estrogen or had a vegetarian diet (Table 1).

The proportion of osteoporosis increased from 18.0% in women aged ≤50 years to 49.6% in those aged ≥65 years. Of the 16 women whose BMI was <19.0, 11 (68.8%) had been diagnosed with osteoporosis. Among the women with a BMI of 19.0–22.0, 11.8% of those aged ≤55 years had osteoporosis and 70.0% of the elderly had osteoporosis. Among women

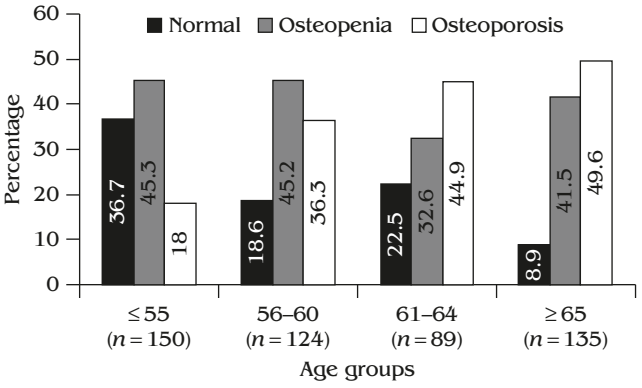


**Fig. 1 — The results of bone density testing (T-score) among 498 postmenopausal women.**

aged ≥65 years ($n$=135), the proportions with osteoporosis were 70.0% for women with a BMI of 19.0–22.0, 51.0% for women with a BMI of 22.1–25.0, and 40.3% for women with a BMI of >25.0. The proportions of osteoporotic women aged 61–64 years ($n$=89) were 50.0% with a BMI of 19.0–22.0, 54.8% with a BMI of 22.0–25.0, and 32.4% with a BMI of >25 (Table 2).

### 3.3. OSTA and its validity

The OSTA index ranged from –6.1 to 4.2. More than half of the subjects had an index less than or equal to the recommended cut-off point of –1 and, thus, were at a high risk of osteoporosis. Among the 200 women identified as being at high risk, 36.0% had

**Table 2 — Proportions of osteoporosis diagnosed by dual energy X-ray absorptiometry stratified by age and body mass index (BMI)***

| | Age (yr) | | | | Total ($N$=498) |
|---|---|---|---|---|---|
| | ≤55 ($n$=150) | 56–60 ($n$=124) | 61–64 ($n$=89) | ≥65 ($n$=135) | |
| BMI | | | | | |
| <19 | 2/4 (50.0) | 4/5 (80.0) | 2/3 (66.7) | 3/4 (75.0) | 11/16 (68.8) |
| 19.0–22.0 | 4/34 (11.8) | 10/23 (43.0) | 6/12 (50.0) | 14/20 (70.0) | 34/89 (38.2) |
| 22.1–25.0 | 15/58 (25.9) | 22/52 (42.3) | 20/37 (54.8) | 25/49 (51.0) | 82/196 (41.8) |
| ≥25.1 | 6/54 (11.1) | 9/44 (20.5) | 12/37 (32.4) | 25/62 (40.3) | 52/197 (26.3) |
| Total | 27/150 (18.0) | 45/124 (36.3) | 40/89 (44.9) | 67/135 (49.6) | 179/498 (35.9) |

*Data presented as $n$ (%).

**Table 3 — Results of the Osteoporosis Self-Assessment Tool for Asians (OSTA) risk index compared with lumbar spine bone mineral density measured by dual energy X-ray absorptiometry (DXA)**

| | DXA (T-score) | | Total |
|---|---|---|---|
| | ≤–2.5 | >–2.5 | |
| OSTA with the original cut-off | | | |
| High risk (index≤–1) | 102 (true positive) | 98 (false negative) | 200 |
| Low risk (index>–1) | 77 (false positive) | 221 (true negative) | 298 |
| Total | 179 | 319 | 498 |
| Sensitivity | 57.0% (95% CI: 52.7, 61.3) | Kappa=0.26 (95% CI: 0.17, 0.34) | |
| Specificity | 69.3% (95% CI: 65.3, 73.4) | | |
| OSTA with a lower cut-off | | | |
| High risk (index≤0) | 138 (true positive) | 162 (false negative) | 300 |
| Low risk (index>0) | 41 (false positive) | 157 (true negative) | 198 |
| Total | 179 | 319 | 498 |
| Sensitivity | 77.1% (95% CI: 73.4, 80.8) | Kappa=0.23 (95% CI: 0.15, 0.30) | |
| Specificity | 49.2% (95% CI: 44.8, 53.6) | | |

CI = confidence interval.

osteopenia and 51.0% had osteoporosis. When the high-risk category was the same as the original definition of the two-level classification and a low BMD value was defined as a T-score of ≤–2.5, the sensitivity and specificity of the OSTA index were 57.0% (95% CI: 52.7, 61.3) and 69.3% (95% CI: 65.3, 73.4), respectively (Table 3). Among women aged 60–70 years, the sensitivity and specificity of the OSTA risk index were 77.1% (95% CI: 63.7, 76.9) and 49.2% (95% CI: 42.0, 56.4), respectively. The accuracy of the OSTA risk index was 64.9% (95% CI: 60.7, 69.8). The agreement between the two tests was fair (Kappa coefficient 0.256) and the OSTA yielded an AUC of 0.630 (95% CI: 0.563, 0.696).

Using a cut-off point of 0 of the OSTA index, we predicted osteoporosis with a sensitivity of 77.1% (95% CI: 73.4, 80.8) and a specificity of 49.2% (95% CI: 44.8, 53.6). Raising the cut-off point to 0, the sensitivity increased by 35.3% but the specificity also decreased by one-third (Table 3). The agreement between the two tests was fair (Kappa coefficient 0.230), and the OSTA yielded an AUC of 0.699 (95% CI: 0.649, 0.806) (Fig. 2).

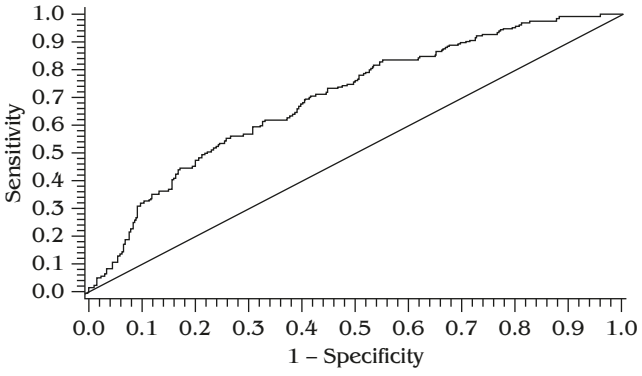


**Fig. 2 — The receiver operating curve for the Osteoporosis Self-Assessment Tool for Asians, using bone mineral density of the lumbar spine (T-score of ≤–2.5) with dual energy X-ray absorptiometry measurement as the gold standard.**

Of the 179 subjects diagnosed with osteoporosis, 77 (25.8%) were at low risk according to the OSTA index (i.e., false negatives) and had a mean body weight of 60.2 kg. About 70% of them were aged ≤60

**Table 4 — Comparison of the characteristics of women with inconsistent Osteoporosis Self-Assessment Tool for Asians (OSTA) results and dual energy X-ray absorptiometry (DXA) test results***

| Characteristics | Results of OSTA screening with reference to DXA tests | | | | | |
|---|---|---|---|---|---|---|
| | True negative ($n$=221) | False negative ($n$=77) | $p^{\dagger}$ | True positive ($n$=102) | False positive ($n$=98) | $p^{\dagger}$ |
| Age (yr) | | | <0.01 | | | NS |
| ≤55 ($n$=150) | 114 (51.6) | 24 (31.2) | | 3 (2.9) | 9 (9.2) | |
| 56–60 ($n$=124) | 59 (26.7) | 30 (39.0) | | 15 (14.7) | 20 (20.4) | |
| 61–64 ($n$=89) | 27 (12.2) | 16 (20.8) | | 24 (23.5) | 22 (22.5) | |
| ≥65 ($n$=135) | 21 (9.5) | 7 (9.1) | | 60 (58.8) | 47 (48.0) | |
| Mean | 56.3±5.8 | 58.4±5.7 | <0.05 | 66.6±6.5 | 64.5±7.0 | <0.01 |
| Body weight (kg) | 62.2±8.5 | 60.2±6.7 | <0.05 | 51.9±8.0 | 52.6±5.4 | NS |
| Height (cm) | 155.7±4.7 | 155.0±4.4 | NS | 149.6±15.6 | 151.6±4.3 | NS |
| Body mass index (kg/m$^2$) | 25.7±3.4 | 25.1±3.1 | NS | 23.0±2.8 | 22.9±2.5 | NS |
| Spine bone mineral density | 0.921±0.11 | 0.706±0.06 | <0.01 | 0.663±0.07 | 0.888±0.1 | <0.01 |
| OSTA | 1.2±1.7 | 0.4±1.1 | <0.01 | −2.9±1.6 | −2.3±1.3 | <0.01 |
| T-score | −0.82±1.3 | −3.1±0.5 | <0.01 | −3.5±0.7 | −1.1±1.3 | <0.01 |
| Years since menopause | 7.2±6.2 | 8.0±6.4 | NS | 14.9±8.3 | 12.6±8.6 | NS |
| Vegetarian diet | 64 (28.9) | 16 (20.8) | NS | 16 (15.7) | 18 (18.4) | NS |
| Currently taking estrogen | 31 (14.0) | 6 (7.8) | NS | 42 (41.2) | 43 (43.9) | NS |
| Currently taking calcium supplements | 77 (34.8) | 28 (36.4) | NS | 9 (8.8) | 17 (17.4) | NS |
| Exercise≥3 times/wk | 142 (64.3) | 50 (64.9) | NS | 48 (47.1) | 45 (45.9) | NS |

*Data presented as $n$ (%) or mean±standard deviation; $^{\dagger}\chi^2$ test or $t$ test between groups with true-negative and false-negative results, and between groups with true-positive and false-positive results. NS = non-significant.

years (mean, 58.4 years). Two-thirds of them reported a frequency of exercise of fewer than three times per week, and 21.9% were vegetarian. Of the 98 women identified as being at high risk but with a T-score that was not ≤−2.5 (i.e., false positives), their mean age was 64.8±7.1 years, and over one-third (38.8%) were aged ≥65 years. Their mean body weight was 52 kg, mean height was 151.6 cm, and average time since menopause was 12.6 years (Table 4). Compared with the truly negative subjects, those incorrectly identified as being at *low risk* were found to have a higher mean age (58.4 years) and a lower body weight (60.2 kg) ($p$<0.05). Those who were incorrectly identified as being in the *high risk* group were 2 years younger than the truly osteoporotic women. Among women aged ≤55 years, the false-negative rate was about 16% (24/114). The false-positive rate was about 20% (42/213) for women aged 55–64 years. The false-negative rate was only 5.2% (7/135) but the false-positive rate was about 34.8% (47/135) among women aged ≥65 years.

## 4. Discussion

We found that the OSTA risk index did not perform very well in identifying women at high risk of osteoporosis. But the accuracy of the OSTA risk index was higher (77.1%) among women aged 60–70 years. The accuracy of the OSTA risk index was unsatisfactory and clearly lower than those observed from a sample of women from eight countries in Asia, from Korea, and from the Philippines (6–8). There may be two reasons for such a difference. First, the mean age of participants in the Asian study was higher (mean age, 62.3 years). In addition, since the participants came from clinics and tertiary care centers, the prevalence of osteoporosis might have been higher in the Asian studies (6,10). The participants in this study were healthy women who had come for a physical check-up. They were mainly volunteers and members of the Buddhist Tzu Chi Relief Foundation and generally represent women in the community with a healthy lifestyle. Second, the gold standard used in our study (spinal DXA) differed from that used in previous studies. The results might not be comparable with other studies that used hip DXA as the reference (6,9,10).

Compared with other studies in which spinal DXA was also used as the gold standard, the validity of the OSTA risk index from this study was lower than in a study of Thai women, but was similar to the finding from a study in China (using a cut-off point of 0) (12). Researchers from Thailand suggested a cut-off point of ≤0 of the OSTA index as being appropriate

to improve the sensitivity of detecting osteoporosis. We found a substantially higher false-positive rate with this cut-off value. So the cut-off point of the OSTA index should be kept as originally categorized (i.e., <−1). The validity of the OSTA risk index was better among women aged 60–70 years. The application of this screening tool seems to be limited to women in early menopause and the very elderly (13).

In this study, two-thirds of the false-negative women were aged <60 years, and they had a mean weight of 60.2 kg. Also, vegetarians and those who did not frequently exercise were more likely to have a false-negative result on the OSTA risk index. During the early years of menopause, most women gain some weight due to having a slower metabolic rate. So the OSTA risk index might not be adequate for identifying the risk among this population. Clinical risk factors, such as menopause before the age of 45 years, steroid use for 6 months or longer, or a family history of a fracture, should be considered when recommending BMD measurements (1,14,15).

In this study, the mean age of women identified as being at high risk with the OSTA risk index but with a T-score of >−2.5 (i.e., false positives) was 64.5 years, with a mean height of 151.6 cm. Their mean body weight was about 5 kg lower than the average of all participants. A low body weight, a longer time since menopause, and loss of body height are risk factors for osteoporosis in the elderly (16). The disagreement between the OSTA risk index and spinal T-scores might have been due to degenerative changes in the lumbar spine among the elderly. Since osteoarthritis of the spine may cause errors in estimating density measurements, this site is less suitable for diagnostic purposes. Among elderly women, errors in the value of spinal DXA measurements due to a degenerative spine should be considered. Therefore, women who have significant height loss should be referred for a hip DXA measurement (1,14). A study in Thailand found that the sensitivity of the OSTA risk index was higher compared to DXA measurements of the femur neck than of the lumbar spine (8). Further study is needed to reassess the validity of the OSTA index with femur neck DXA measurements among the elderly in Taiwan.

The following limitations of our study deserve mention. First, our sample was from one hospital, and the results might not be representative of the general population of Taiwan. Generalization to the population of Taiwanese postmenopausal women is limited. Second, a spinal DXA was used as the gold standard, but DXA of the hip is more suitable for the elderly. A spinal measurement may be particularly important in younger postmenopausal women since it may show bone loss changes earlier than in the hip (1). The results of this study provide information for younger postmenopausal women. Third, most participants were volunteers for a Buddhist Relief foundation; their lifestyles and bone health may differ from those of the general population. Finally, since information about lifestyles and reproductive history were self-reported, a recall bias may have occurred.

In conclusion, the OSTA index can be used as a convenient tool to help target high-risk women aged 60–70 years for a DXA measurement. A lower OSTA index is associated with a greater likelihood of osteoporosis. Clinical risk factors and the OSTA index should be combined to assess women aged ≤60 years. Because of its simplicity, the OSTA index may be the most useful means by which primary physicians can identify postmenopausal women who would benefit most from BMD testing (17). Further study of the validity of the OSTA index among elderly with a larger sample size and in different populations should be conducted with hip DXA measurements as the reference.

## References


1. World Health Organization. Prevention and management of osteoporosis. A report of a WHO scientific group. *WHO Technical Report Series 921*. Geneva: WHO, 2003: 53–120.
2. Braithwaite RS, Col NF, Wong JB. Estimating hip fracture morbidity, mortality and costs. *J Am Geriatr Soc* 2003; 51:364–70.
3. Center JR, Nguyen TV, Schneider D, Sambrook PN, Eisman JA. Mortality after all major types of osteoporotic fracture in men and women: an observation study. *Lancet* 1999; 353:878–82.
4. Kado DM, Duong T, Stone KL, et al. Incident vertebral fractures and mortality in older women: a prospective study. *Osteoporos Int* 2003;14:589–94.
5. Boonen S, Autier P, Barette M, Vanderschueren D, Lips P, Haentjens P. Functional outcome and quality of life following hip fracture in elderly women: a prospective controlled study. *Osteoporos Int* 2004;15:87–94.
6. Koh LK, Sedrine WB, Torralba TP, et al. A simple tool to identify Asian women at increased risk of osteoporosis. *Osteoporos Int* 2001;12:699–705.
7. Chaovisitsaree S, Namwongprom SN, Morakote N, Suntornlimsiri N, Piyamongkol W. Comparison of osteoporosis self assessment tool for Asian (OSTA) and standard assessment in Menopause Clinic, Chiang Mai. *J Med Assoc Thai* 2007;90:420–5.
8. Geater S, Leelawattana R, Geater A. Validation of the OSTA index for discriminating between high and low probability of femoral neck and lumbar spine osteoporosis among Thai postmenopausal women. *J Med Assoc Thai* 2004; 87:1286–92.
9. Park HM, Sedrine WB, Reginster JY, Ross PD. Korean experience with the OSTA risk index for osteoporosis: a validation study. *J Clin Densitom* 2003;6:247–50.
10. Li-Yu JT, Llamado LJ, Torralba TP. Validation of OSTA among Filipinos. *Osteoporos Int* 2005;16:1789–93.
11. Yang NP, Lin T, Wang CS, Chou P. Correlation of osteoporosis screening by quantitative ultrasound of calcaneous and

Osteoporosis Self-Assessment Tool for Asians in Taiwanese. *J Formos Med Assoc* 2004;103:130–6.
12. Lu C, Chen D, Cai Y, Wei S. Concordance of OSTA and lumbar spine BMD by DXA in identifying risk of osteoporosis. *J Orthop Surg* 2006;1:14.
13. Martínez-Aguilà D, Gómez-Vaquero C, Rozadilla A, Romera M, Narváez J, Nolla JM. Decision rules for selecting women for bone mineral density testing: application in postmenopausal women referred to a bone densitometry unit. *J Rheumatol* 2007;34:1307–12.
14. National Osteoporosis Foundation. *Physician's Guide to Prevention and Treatment of Osteoporosis.* Washington (DC): National Osteoporosis Foundation, 2003. Available from http://www.guideline.gov/summary/summary.aspx?doc_id=3862&nbr=003073&string=osteoporosis
15. The Taiwanese Osteoporosis Association. *Guideline of Prevention of Osteoporosis among Taiwanese Women.* Taipei: The Taiwanese Osteoporosis Association, 2005:2–4.
16. Ooms ME, Lips P, Van Lingen A, Valkenburg HA. Determinants of bone mineral density and risk factors for osteoporosis in healthy elderly women. *J Bone Miner Res* 1993;8:669–75.
17. Wehren LE, Siris ES. Beyond bone mineral density: can existing clinical risk assessment instruments identify women at increased risk of osteoporosis? *J Intern Med* 2004;256:375–80.