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The Diagnostic Value of the Osteoporosis Self-assessment Tool for Asians in Vietnamese Postmenopausal Women

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Abstract

BACKGROUND: Osteoporosis is a common disease that affects many women in the postmenopausal period. Dual-energy X-ray absorptiometry (DXA) is a simple and non-invasive method used to diagnose osteoporosis. The Osteoporosis Self-Assessment Tool for Asians (OSTA) is an osteoporosis risk assessment toolkit, used for menopausal women in Asia.

AIM: This study aimed to evaluate the diagnostic values of the OSTA index in determining the risk of osteoporosis in postmenopausal women.

MATERIALS AND METHODS: This cross-sectional study was conducted on 919 postmenopausal women to determine the value of OSTA in osteoporosis risk assessment. The bone density was measured using the DXA method in the lumbar spine and femoral neck.

RESULTS: Based on the receiver operating characteristic curve, the sensitivity and specificity of OSTA were 70.3% and 63.6% at the cut-off of ≤ −1.4 at the femoral neck or lumbar spine or both (p = 0.005). At a cut-off point of ≤ −1 at one of two-position or both, the OSTA index showed a specificity of 87.23%, sensitivity of 66.08%, the positive predictive value of 46.90%, and the negative predictive value of 93.78% in predicting the osteoporosis risk.

CONCLUSIONS: The OSTA index is a simple tool that is highly sensitive and specific in predicting the risk of osteoporosis in postmenopausal women.

Introduction

Today, osteoporosis is the most common disease in the elderly. It is recognized as a common cause of fracture in this population. In 2000, there was an estimated number of 9.0 million osteoporotic fractures worldwide, including 1.6 million fractures of the hip, 1.7 million fractures of the forearm, and 1.4 million clinical vertebral fractures [1]. These fractures are known to considerably affect the individual's quality of life. Therefore, all postmenopausal women need to be screened for osteoporosis to find an appropriate treatment plan.

In general, it is important to the early identify the risk of osteoporosis before choosing a suitable treatment plan for reducing the risk of osteoporosis-related fractures. Dual-energy X-ray absorptiometry (DXA) is the gold standard for diagnosing osteoporosis [2]. However, it is an expensive method, which is not available in many health facilities, especially in district facilities. In 2001, Koh *et al*. registered on behalf of the Osteoporosis Self-Assessment Tool for Asians (OSTA) Research Group, which has developed a new tool for determining the risk of osteoporosis based on the results of the multiple variable models. The research group had proved that the OSTA is an osteoporosis risk assessment toolkit used for menopausal women in Asia [3]. It is a simple and inexpensive tool, which only relies on the individual's age and weight. Although it is not used for the definitive diagnosis of osteoporosis or low bone mineral density (BMD), it can be applied for identifying women who are exposed to a low risk of BMD, suggesting osteoporosis. This study aimed to evaluate the diagnostic value of the OSTA index in determining the risk of osteoporosis in postmenopausal Vietnamese women.

Materials and Methods

This cross-sectional study was conducted on 919 postmenopausal women presenting to the outpatient clinic of Vinh Medical University Hospital (Vinh, Vietnam) from May to December 2018. The subjects were randomly chosen with the following inclusion criteria: Age range of 40–80 years and lack of menstruation for 12 months. On the other hand, the exclusion criteria were as follows: Diseases associated with rapid bone loss (i.e., thyroid disease, primary hyperparathyroidism, renal disease, AIDS, and Cushing

syndrome); hypertension; diabetes mellitus; prolonged use of drugs affecting osteoporosis (corticosteroids, thyroid hormones, estrogen, bisphosphonate, calcitonin, and Vitamin D); and use of osteoporosis treatment; and history of fragility fracture. The data on the age and weight of all participants are shown in Table 1.

Table 1: Age, weight and the value of OSTA index, T-score and Z-score of the subjects

Age (year)	
Median	61.5
Group of age (number)	
≥ 65	280
< 65	639
Weight (kilogram)	
Median	44
OSTA	
Median	−3.5
Level of OSTA (n, %)	
Low (>-1)	482 (52.4)
Moderate (-4 to -1)	316 (34.4)
High (< -4)	121 (13.2)
T-Score (median, inter-quartile 25th and 75th)	
In the hip	−1.4 (−1.7; 0.1)
In the spine	−1.7 (−0.5; −2.5)
BMD (n, %)	919 (100)
Normal	272 (29.60)
Low bone mass	412 (44.83)
Osteoporosis	235 (25.57)

OSTA index and osteoporosis risk

The OSTA index was measured as follows:

OSTA index= (Weight (kg) – Age (years)) ×0.2

The classification of the osteoporosis risk is based on the value of OSTA. If the OSTA is below −4, the risk is graded high. If the OSTA is between −4 and −1, the risk is graded moderate. Moreover, the risk is graded low with OSTA >−1 [3]. The category of OSTA participants is shown in Table 1.

BMD measurements

The BMD of all subjects was measured by DXA, using a BMD machine (Hologic, Germany) in the diagnostic imaging room of the Outpatient Department of Vinh Medical University. The BMD measurements in the hip and spine (L1 to L4) areas were used to establish or confirm the diagnosis of osteoporosis. It should be noted that the World Health Organization (WHO) definition of osteoporosis is based on the BMD measurements [4]. The T-score was a comparison of the patient's bone density with healthy, young individuals of the same sex. The T-scores were computed based on the National Health and Nutrition Examination Survey (NHANES) reference data for US Whites (aged between 20 and 29) [5].

Statistical analysis

Data were statistically analyzed in MedCal 20.0 software. The normal and abnormal distribution variables were presented as median, interquartile 25th, and 75th, standard deviation. The difference between groups was tested with a t-test and Mann–Whitney's U-test based on the distribution. The results were considered to be significant at $p<0.05$. The receiver operating characteristic curve analysis was performed to estimate the diagnostic values of the OSTA index in predicting the osteoporosis risk. With the cut-off values, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated.

Results

The BMD index was used to diagnose osteoporosis with T- score at or below −2.5 so that we estimate the diagnostic values of the OSTA index in our subjects. T-scores were estimated based on the BMD values at the femoral neck or lumbar spine or both. Figure 1 showed the sensitivity and specificity of the OSTA index was 70.3% and 63.6 %, respectively, with the cut-off value of −1.4 (p = 0.005, CI 95%: 8.80–20.15).

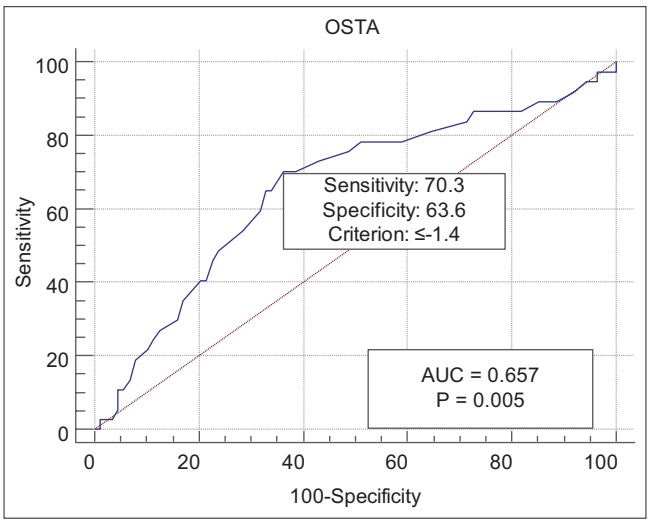

Figure 1: The receiver operating characteristic curve analysis of the diagnostic value of OSTA for osteoporosis

If the OSTA cut-off value of −1 and BMD index based on DXA in the spine were used for osteoporosis diagnosis, the sensitivity, specificity, PPV, and NPV of the OSTA index were 85.86%, 64.31%, 42.33%, and 94.19%, respectively. If the OSTA cut-off value of −1 and BMD index based on DXA in the hip were used for osteoporosis diagnosis, the sensitivity, specificity, PPV, and NPV of the OSTA index were 94.18 %, 51.16%, 18.54%, and 98.96%, respectively. If the OSTA cut-off value of −1 and BMD index based on DXA in both positions (the hip and spine) were used for osteoporosis diagnosis, the sensitivity, specificity, PPV, and NPV of OSTA index were 66.08%, 87.23%, 46.90%, and 93.78%, respectively (Table 2).

The subjects were divided into two groups with the age older than 65 and younger than 65. The value of BMD in both positions was significant different between the two groups. The older than 65 group had lower BMD

Table 2: The Se, Sp, PPV, and NPV of OSTA in osteoporosis diagnosis at the cut-off value of−1

Diagnosis values of OSTA with cut off value−1	Osteoporosis diagnosis based on BMD using DXA in the spine	Osteoporosis diagnosis based on BMD using DXA in the hip	Osteoporosis diagnosis based on BMD using DXA in both hip and spine positions
Sp (%)	64.31	51.16	87.23
Se (%)	86.85	94.18	66.08
PPV (%)	42.33	18.54	46.90
NPV (%)	94.19	98.96	93.78

Sp: Specificity, Se: Sensitivity, PPV: Positive predictive value, NPV: Negative predictive value.

than the other group (in the hip, 0.35 versus 1.0 g/cm^2; in the spine, 0.7 vs. 0.86 g/cm^2, respectively). In the older than 65 age group, the percentage of osteoporosis subjects was higher than in the other group (92.85% vs. 27.70%) (Table 3).

The percentage of each type of osteoporosis as classification by the WHO in each level of the OSTA index was presented in appendices.

Discussion

This study revealed that the OSTA index is an effective tool for screening osteoporosis in postmenopausal women in Vietnam. The osteoporosis risk assessment based on OSTA indicated the BMD of most women correctly in this study. Our results were consistent with some previous studies performed in some Asian countries [6], [7], [8], [9], [10], [11]. This study was performed in a large number of participants in Vietnam. Although being an Asian country, women in Vietnam had differences in race, ethnic, lifestyle, nutrition habits, occupation, chronic disease, and many risks which affected the bone status. In our study, the participants were chosen randomly and excluded the other points that were not used in the OSTA index. Vu *et al*. had shown the percentages of osteoporosis in Vietnamese women in the age groups 50–59, 60–69, and 70–79 were 8.4%, 30.5%, and 56.2%, respectively [12]. The research of Finkensten *et al*. in a multiethnic cohort of women in 2007 has shown that the menopausal base average age of Chinese and Japanese women was 65 and 63 [13]. These two Asian countries are similar to our country so our research has chosen 65 as the index to divide the subjects into two groups. Advancing age is an important risk factor for osteoporosis due to decreased estrogen levels in women approaching the postmenopausal period. In our study, we found that with the age older than 65, the percentage of osteoporosis was significantly higher than the age younger than 65. The BMD of the older than 65 group was significantly lower than the younger age group. That would be a reason for the higher percentage of osteoporosis in the older group. Accordingly, age would be one risk factor for osteoporosis. Besides, weight is an indicator, which is strictly associated with bone characteristics [14], [15]. So far, OSTA has been shown to be a simple and effective tool in eight Asian countries [3]. This study had validated the high diagnostic values of OSTA and its applications in Vietnam. The high NPVs had been shown the ability to be used as a cheap and effective screening test which is suitable for many medical facilities in Vietnam.

If only based on the BMD result in the femoral neck, our study showed a higher sensitivity than the specificity of OSTA in diagnosing osteoporosis. This result was similar to the research of Park *et al*. on 1,101 postmenopausal women who had femoral neck BMD measurements by DXA in Korea. The OSTA index showed 87% sensitivity and 67% specificity in diagnosing osteoporosis. The prevalence of osteoporosis ranged from 2% among women in the low-risk category (OSTA score >−1) to 64% in the high-risk category (OSTA score<−4). They concluded that the OSTA index is a suitable tool for assessing the risk of osteoporosis in Korean women [9]. These results also indicated that the femoral neck bone density might be correlated more strictly to weight and age.

Another study by Chaovisitsaree and Namwongprom (2007) on Thai, premenopausal women showed that the OSTA index has low sensitivity (36–48%) but high specificity (71–75%) to identify bone deficiency and osteoporosis in premenopausal women [10]. This study did not have the same subjects as our study. All the participants of our study were postmenopausal who had an older age and a higher percentage of osteoporosis than the premenopausal women. Hence, it could be the reason for lower sensitivity and specificity when using OSTA for those subjects.

Like others studies, this study had some limitations. First, some risk factors for osteoporosis, such as lifestyle, diet, and working conditions, were not examined in this study. Second, this study had a cross-sectional design; therefore, we could not estimate the changes in each individual or group over time.

Table 3: The value of BMD, T-score, OSTA index and the prevalance of osteoporosis in two age groups

	Median BMD (gr/cm^2)		T-score		OSTA	The percentage of normal and osteoporosis (%)	
	In the hip	In the spine	In the hip	In the spine		Normal	Osteopo-rosis
Age<65	1.00	0.86	−0.37	−1.07	0.48	462 (72.30)	177 (27.70)
Age≥65	0.35	0.7	−1.8	−2.46	−4.5	20 (7.15)	260 (92.85)
p-value	p^{1*} < 0.001	p^{2*} < 0.001	p^{3*} < 0.001	p^{4*} < 0.001	p^{5*} < 0.001		

*Using independent sample median test.

Conclusions

The value of the OSTA index in the prediction and diagnosis of osteoporosis was validated in this study among postmenopausal Vietnamese women.

Ethical issues

The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Vinh Medical University approved this study and all study protocols. Accordingly, written informed consent was taken from all participants before any intervention.

Authors' Contribution

V.T. Nguyen, Q.T. Huynh, T.P.L. Dam, and T.M. Hoang were the principal investigators of the study. V.T. Nguyen and Q.T. Huynh were included in preparing the concept and design. V.T. Nguyen and Q.T. Huynh revisited the manuscript and critically evaluated the intellectual contents. All authors participated in preparing the final draft of the manuscript, revised the manuscript, and critically evaluated the intellectual contents. All authors have read and approved the content of the manuscript and confirmed the accuracy or integrity of any part of the work.

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