ORIGINAL ARTICLE

VALIDITY OF OSTEOPOROSIS SELF-ASSESSMENT TOOL FOR ASIANS (OSTA) FOR MASS SCREENING AMONG DIVERSE POPULATION OF MALAYSIA.

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Abstract

Introduction: Osteoporosis Self-assessment Tool for Asian (OSTA) has been recommended as a valid tool for screening osteoporosis in many countries. In Malaysia, effectiveness of OSTA has been validated only for Malay women. However, there is no such data for heterogeneous Malaysian population including Chinese, Malay and Indians. **Methods:** One hundred postmenopausal women from Kinta district, Ipoh, Malaysia were randomly selected. After measuring the body weight, OSTA scoring was calculated. Bone mineral density (BMD) was measured on the same day. **Results:** The sensitivity and specificity of OSTA for all participant groups by comparing with BMD results were 52.6% and 67.7% for spine and 46.7% and 65.5% for hip. This was in agreement with most of the other studies from Asian region. **Conclusion:** By our findings it is not conclusive to recommend the OSTA for screening purpose like other studies. It is advisable that a larger study should be done in the future involving many participants, in collaboration with government hospital to reduce the cost for BMD measurement.
Keywords: *OSTA, osteoporosis, BMD, screening, postmenopausal*

Introduction

Osteoporosis is defined as a chronic progressive systemic skeletal disease characterized by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture [1].

With socio-economic development in most countries worldwide and increasing ratio of elderly people in the population, osteoporosis has become one of the most prevalent and costly health problems [2]. The public health impact of osteoporosis stems from its association with fractures of the hip, spine and forearm[2]. It is estimated that 22 million women and 5.5 million men have osteoporosis in 2012 in the Europe; and there are 3.5 million new fragility fractures comprising 620,000 hip fractures, 520,000 vertebral fractures, 560,000 forearm fractures and 1,800,000 other fractures. The economic burden of those fragility fractures was estimated at € 37 billion which may increase by 25 % in 2025[2]. Between 10% and 20% of patients sustaining a hip fracture die within a year of the event, and among those who survive, almost two-thirds remain disabled[3].

Asia is the region expecting the most dramatic increase in hip fractures during coming decades; by 2050 half of all hip fractures worldwide will occur in Asia[4]. The number of hip fracture cases for men and women in Malaysia is 88 and 218 per 100,000 populations[5].

There are differences in hip fracture incidence depending upon ethnicity. Race-specific incidence data showed that the fracture rates are highest among the Chinese (160 per 100 000) followed by Indians (150 per 100 000) and Malays (30 per 100 000) [6].

The results of the Asian Osteoporosis Study suggested that many lifestyle factors might be associated with osteoporosis. To name a few, these include a low dietary calcium intake, a sedentary lifestyle, cigarette smoking and alcoholism [5]. Several drugs have been found to be useful for the prevention of fractures. Alendronate is effective in preventing most types of fragility fractures,[7] while the selective oestrogen receptor modulators (SERM) have been found to be effective in preventing vertebral fractures [8].

Therefore lifestyle modifications and addition of medications can prevent fragility fractures thereby improving the quality of life. It will also reduce the burden on spending on hospital care. Thus stress is to be placed on identifying patients at risk of osteoporosis and undertaking corrective measures at the earliest.

In the absence of a fragility fracture, the gold standard to diagnose osteoporosis is by measuring bone mineral density (BMD), using dual energy X-ray absorptiometry (DXA)[9]. Apart from women over 65 years old, the group which would benefit most from a scan are those under 65 years old who have multiple risk factors, such as a history of fracture, cigarette smoking and family history of fractures.

There is also an Osteoporosis Self-Assessment Tool for Asians (OSTA) which is a quick and easy test that helps to discover the risk of osteoporosis[10]. It has high sensitivity and acceptable specificity for the identification of women at risk of osteoporosis in previous studies [10, 11]. However, a Chinese cohort study reported poor results when validating use of the OSTA for identifying postmenopausal osteoporosis in lumbar spine by using DXA measurements[12]. Therefore the use of OSTA should be validated across diverse populations.

The exact magnitude of osteoporosis in Malaysia is not known. To our knowledge there is no Malaysian prediction algorithm as the Malaysian Osteoporosis Society recommends using the Singapore prediction algorithm. There is also no data on the effectiveness of OSTA in Malaysian population by comparing it to BMD or to fracture risk assessment tool (FRAX). Previous studies have shown that there is increase in hip fracture among Chinese population in Malaysia [6]. In Ipoh the demographic pattern is 53.5% Chinese, 29.8% Malays and 16% Indians[13]. Therefore the

incidence of osteoporosis may be high in Ipoh. There is a study validating the OSTA among Malay population[14], but there is no study mentioning about the validity of OSTA for screening of osteoporosis for each three races.

The aim of this prospective study was to look into the effectiveness of OSTA as an assessment tool for identifying postmenopausal women at increased risk of primary osteoporosis among the different races in Malaysia. We postulated that osteoporosis could be accurately predicted by OSTA.

Materials and Methods

This was a cross sectional study. Study period was 6 months. (January to June 2015). Study population included 100 randomly selected postmenopausal women of Kinta district, Ipoh, Malaysia, who came to various clinics for other reasons.

Inclusion criteria:

1. Willingness to participate in the study and ability to read and provide informed consent,
2. No history of medical risk factors for osteoporosis such as smoking, excessive alcohol consumptions, lack of exercise, no history of metabolic bone disease, rheumatoid arthritis, metastasis to bone and any significant renal impairment
3. No history of having steroids, anti-resorptives (Bisphosphonates, Raloxifene, Denosumab) or 'bone formation' medications (Teriparatide, Abloparatide) currently or within the last three months.

Exclusion criteria:

1. Women with any history or evidence of risk factors
2. Women who has menopause before 40 years of age,
3. Women with previous fractures or replacement of hips and
4. History of prolonged immobility.

Assessment of OSTA was done for all participants. The OSTA is calculated based on age and body weight using the formula "[Body weight (kg) - age (year)] × 0.2". The decimal digits are then disregarded. Subjects are then classified based on risk of osteoporosis as high risk subgroup (index < -4) intermediate risk subgroup (index -1 to -4) and low risk sub group (index > -1).

They all subsequently underwent a BMD scan of the hip and spine by using "GE Prodigy Primo" machine. BMD is described as a T-score, which reflects the number of standard deviations (SD) above or below the mean in healthy young adults. If T score is equal or more than -1, it is assumed as normal. If T-score is between -1 to -2.5 it is osteopenia. In osteoporosis T-score is less than -2.5. If T-score is less than -2.5 with associated fracture, it is termed as severe osteoporosis.

Data was then analyzed to observe the correlation between OSTA and BMD scan and the effectiveness of OSTA. All data was entered into SPSS version 23. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for all the 3 major races in Malaysia.

Results

Out of 100 participants, 45 were Chinese, 19 were Indians and 36 were Malays. Mean age of participants was 64.16 years (range 52-80 years). The mean BMI was 25.039 kg/m2 (range 18.0–33.6).

Among the Chinese population, out of 45 participants, 19 were in the group of OSTA medium and high risk category. On analyzing their BMD results, 15 participants had osteopenia/osteoporosis in the spine and 13 participants had osteopenia/osteoporosis in the hip. More than half of participants (27 for spine and 28 for hip) had reduced BMD but positive OSTA score could be identified in only 19 participants [**Table 1**]. Based on these figures, sensitivity and specificity of OSTA for spine of Chinese population were 55.6 % and 77.8% and

for hip were 46.4% and 64.7%. PPV and NPV for spine of Chinese population were 79.0% and 53.9% and for hip were 68.4% and 42.3%.

Among the Indian population, out of 19 participants, four were in medium and only one in high risk of OSTA group. On analyzing their BMD results, only two had osteopenia in the hip. Among 14 in low OSTA risk group, 2 were found to have osteopenia in spine. One participant in high OSTA group had normal BMD [**Table 2**]. Sensitivity and specificity of OSTA for spine of Indian population were 0% and 70.9% and for hip were 100% and 82.35%. PPV and NPV for spine of Indian population were 0% and 85.7% and for hip were 40% and 100%. The results were ambiguous for Indians. It may be due to small sample size.

Among the Malay population, out of 36 participants, there were 16 in OSTA risk group of medium and high. On analyzing the BMD results, among the four participants in the high OSTA risk group, three were osteoporotic in both spine and hip. But among 12 of medium OSTA risk group, 10 were normal in spine and nine were normal in hip [**Table 3**]. Sensitivity and specificity of OSTA for spine of Malay population were 55.56% and 59.26% and for hip were 40% and 52.38%. PPV and NPV for spine of Malay population were 31.25% and 80% and for hip were 37.5% and 55%.

Among all participants, 40% (N= 40) were in medium and high OSTA risk groups [**Table 4**]. Among them 50% (20) had reduced BMD in spine (20 true positive cases and 20 false negative cases) and 55% (21) had reduced BMD in hip. (21 true positive cases and 19 false positive cases).

Out of the 60 OSTA low risk participants, on analyzing their BMDs of spine, 42 turned out to be normal BMD, 15 were osteopenic and 3 were osteoporotic. Therefore false negative cases were 18. On analyzing their hip BMDs, 36 were normal, 22 were osteopenic and 2 were osteoporotic. Therefore, false negative cases were 24.

Out of the 33 OSTA medium risk group participants, 18 turned out to be normal BMD in the spine, 15 were osteopenic and none were osteoporotic (False positive 18). In the hip, 17 were normal, 14 were osteopenic and 2 were osteoporotic (False positive 17).

Out of the 7 OSTA high risk group participants, 2 turned out to have normal BMD, one was osteopenic and 4 were osteoporotic in the spine. (False positive 2) In the hip, 2 were normal, one was osteopenic and 4 were osteoporotic (False positive 2).

Sensitivity and specificity of OSTA for spine of all participants were 52.6% and 67.7% and for hip of all participants were 46.7% and 65.5%. Positive predictive value (PPV) and negative predictive value (NPV) for spine of all participants were 50% and 70% and for hip were 52.5 % and 60%.

Discussion

In order for a screening test to be effective, it must be inexpensive and easy to administer, with minimal discomfort and morbidity to the participant. The results must also be reproducible. Validation of OSTA has been done in many Asian countries and approved to be useful as evidenced by the studies mentioned below.

In 2001, a Japanese study participated by 1123 postmenopausal women had described the sensitivity and specificity of OSTA as 98% and 29% respectively[15]. In a Korean study participated by 1101 postmenopausal women, sensitivity of OSTA was 87% and specificity was 67% [16]. A Singaporean research participated by 135 postmenopausal women described sensitivity of OSTA as 91% and specificity as 59%[17]. Among Filipinos, the sensitivity of OSTA was 97% and specificity was 59% [18]. Chinese studies have mentioned sensitivity and specificity of OSTA as ranging from 57% to 66% and 63% to 76% respectively[12, 19]. Sensitivity and specificity of OSTA were 73.1%, 62.0% in Taiwan[20]. In a Malaysian study done in 2012 and participated by 152 Malay women, the sensitivity was 87.5%, specificity was 95.8%, positive predictive value

(PPV) was 0.538 and negative predictive value (NPV) was 0.993[14].

The sensitivity of OSTA ranged from 57% to 98% and specificity ranged from 29% to 96% respectively in all the above mentioned international Asian studies. In our findings, the overall sensitivity was slightly below this range at 52.6%. However, our overall specificity was within this range, at 68%. On subgroup analysis, based only on BMD measurement of the spine, the sensitivity and specificity of OSTA in the Chinese population were 55.6% and 77.8%. Sensitivity and specificity of OSTA for spine BMD of Malay population were 55.56% and 59.26%. The results were ambiguous for the Indian race and this may be due to small sample size.

The limitation of this study is the number of participants. It is very less than the other studies especially if analysis was done according to races. The cost of measuring the BMD at private sector was the limiting factor for including more participants. By our findings it is not conclusive to comment that the OSTA can be used for screening purpose like other studies.

Conclusion

By our findings it is not conclusive to recommend the OSTA for screening purpose like other studies although the findings are within the range of results done by different persons. It is advisable that a larger study should be done in the future involving many participants, in collaboration with government hospital to reduce the cost for BMD measurement.

Data Availability

The BMD and OSTA data used to support the findings of this study are available from the corresponding author upon request.

Conflict of Interest

We have no conflict of interest to declare.

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Table 1: Correlation of OSTA results and BMD results among Chinese race

Race	BMD results		OSTA	Low	Medium	High	Total
			Total	**26**	**17**	**2**	**45**
		Normal		14	4	0	18
	Spine	Osteopenia		10	13	1	24
		Osteoporosis		2	0	1	3
	PPV		*79.0%*				
	NPV		*53.9%*				
	Sensitivity		*55.6%*				
CHINESE (45%)	*Specificity*		*77.8%*				
		Normal		11	6	0	17
	Hip	Osteopenia		13	9	1	23
		Osteoporosis		2	2	1	5
	PPV		*68.4%*				
	NPV		*42.3%*				
	Sensitivity		*46.4%*				
	Specificity		*64.7%*				

Table 2: Correlation of OSTA results and BMD results among Indian race

Race	BMD results		OSTA	Low	Medium	High	Total
			Total	**14**	**4**	**1**	**19**
		Normal		12	4	1	17
	Spine	Osteopenia		2	0	0	2
		Osteoporosis		0	0	0	0
	PPV		*0%*				
	NPV		*85.7%*				
	Sensitivity		*0%*				
INDIAN (19%)	*Specificity*		*70.9%*				
		Normal		14	2	1	17
	Hip	Osteopenia		0	2	0	2
		Osteoporosis		0	0	0	0
	PPV		*40.0%*				
	NPV		*100%*				
	Sensitivity		*100%*				
	Specificity		*82.4%*				

Table 3: Correlation of OSTA results and BMD results among Malay race

Race	BMD results		OSTA	Low	Medium	High	Total
			Total	**20**	**12**	**4**	**36**
		Normal		16	10	1	27
	Spine	Osteopenia		3	2	0	5
		Osteoporosis		1	0	3	4
	PPV		*31.3%*				
	NPV		*80.0%*				
	Sensitivity		*55.6%*				
MALAY (36%)	*Specificity*		*59.3%*				
		Normal		11	9	1	21
	Hip	Osteopenia		9	3	0	12
		Osteoporosis		0	0	3	3
	PPV		*37.5%*				
	NPV		*55.0%*				
	Sensitivity		*40.0%*				
	Specificity		*52.4%*				

Table 4: Correlation of OSTA results and BMD results among all study population

Race	BMD results		OSTA	Low	Medium	High	Total
			Total	**60**	**33**	**7**	**100**
		Normal		42	18	2	62
	Spine	Osteopenia		15	15	1	31
		Osteoporosis		3	0	4	7
	PPV		*50.0%*				
	NPV		*70.0%*				
	Sensitivity		*52.6%*				
TOTAL (100%)	*Specificity*		*67.7%*				
		Normal		36	17	2	55
	Hip	Osteopenia		22	14	1	37
		Osteoporosis		2	2	4	8
	PPV		*52.5%*				
	NPV		*60.0%*				
	Sensitivity		*46.7%*				
	Specificity		*65.5%*				

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