Comparison of OSTA Index and KKOS Scoring System for Prediction of Osteoporosis in Postmenopausal Women Who Attended Siriraj Menopause Clinic

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Objective: *To compare diagnostic performance of the Osteoporosis Self-Assessment Tool for Asians (OSTA) index and Khon Kaen Osteoporosis Study (KKOS) scoring system with standard measurement of bone mineral density (BMD) by dual energy X-rays absorptiometry (DEXA) for screening osteoporosis and to determine osteoporosis risk factors in postmenopausal women who attended the Siriraj Menopause Clinic, Siriraj Hospital*

Subjects: *Four hundred forty one postmenopausal women who attended the Siriraj menopause clinic, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand and had BMD measurement by DEXA and had a diagnostic test were included in the study.*

Material and Method: *The data were collected from medical records. Subjects who met the inclusion criteria, without exclusion criteria were collected data and calculated for OSTA index and KKOS score. Both indices at ≤ -1 were classified as high risk of osteoporosis. Sensitivity, specificity, PPV, NPV, and AUC of OSTA index, and KKOS score were compared. Risk factors for osteoporosis were analyzed.*

Results: *The prevalence of osteoporosis was 19.7%, 18.8% for osteoporosis of lumbar spine, 2.3% for osteoporosis of femoral neck, and 2% for osteoporosis of total hip. The OSTA index in identifying osteoporosis at least one site of femoral neck, total hip or lumbar spine at original cut point of ≤ -1 had sensitivity and specificity of 51.7% and 77.4% respectively and KKOS at original cut point of ≤ -1 had sensitivity and specificity of 56.3% and 71.8% respectively. Sensitivity of OSTA index was 80% at femoral neck, 77.8% at total hip, and 49.4% at lumbar spine. KKOS had sensitivity at femoral neck, total hip and lumbar spine of 80%, 77.9%, and 54.2% respectively. Specificity of KKOS at femoral neck, total hip and lumbar spine were slightly lower than OSTA index. Age ≥ 65 years, family history of osteoporosis, and history of fracture at age > 45 years found to be risk factors for osteoporosis with odd ratio of 9.0, 2.7, and 5.3 respectively.*

Conclusion: *Both OSTA index and KKOS scoring system had good performance in identifying osteoporosis of femoral neck and total hip but both indices had low sensitivity in identifying osteoporosis of spines. The authors recommend using OSTA index for screening osteoporosis because it is comparable in diagnostic performance and OSTA is more convenient and simpler than KKOS scoring system.*

Keywords: *Osteoporosis, OSTA index, KKOS scoring system*

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Osteoporosis is a disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk[1]. Prevalence of osteoporosis in Thai menopausal women is 39% for lumbar spine and 30% for femoral neck[2]. Gold standard method for diagnosis of osteoporosis is bone mineral density (BMD) measurement by dual energy X-ray absorptiometry (DEXA) at lumbar spine and hip[3]. Value of BMD more than 2.5 SD below the average value of peak bone mass of healthy adult (T-score ≤ -2.5) is criteria defined as osteoporosis by WHO. However, BMD measurement is not widely available; many clinical risk indices were developed to identify women at risk for osteoporosis.

In Thailand, Thai Osteoporosis Foundation recommended using Osteoporosis Self-Assessment Tools for Asians (OSTA) and Khon Kaen Osteoporosis Study (KKOS) scoring system as screening test for osteoporosis. OSTA based on only two variables, age

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and body weight, has been developed and performed well for classifying the risk of osteoporosis among postmenopausal Asian women[4]. Limitation of OSTA is the samples mostly derived from Chinese women (59%) while 11% was Thai women. Khon Kaen Osteoporosis Study (KKOS) score which is the Thai-specific clinical risk score based on age and body weight was developed and is sensitive and specific, but had modest positive predictive value[5].

Up to date, there were two previous studies in Thai postmenopausal women comparing OSTA index and KKOS score. Ongartboon P[6] reported that both indices had the comparable sensitivity and specificity, while Wiriyasirivaj B[7] concluded that OSTA index was more convenient and effective than KKOS scoring system and suggested to change the cut point to zero. The former study included young postmenopausal women (aged 35-70), while the latter study included surgical menopause and both studies included women who received hormonal therapy. Postmenopausal women younger than 45 is indicated for BMD testing, while hormonal therapy has positive effect to bone mass. Thus, the present study was designed to compare the diagnostic performance of the OSTA index and KKOS scoring system in identifying osteoporosis in Thai natural menopausal women age 45 years or more who did not take hormonal therapy and to determine risk factors of osteoporosis.

Material and Method

The present study was conducted between May and October 2011 at Siriraj menopause clinic, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. The present study was approved by the Siriraj Institutional Review Board.

The data were collected from medical records of postmenopausal women who attended the Siriraj menopause clinic between 2003 and 2011. All subjects were natural menopause after 45 years old and had BMD measurement at lumbar spine and hip by DEXA. Subjects were excluded from the present study if they had 1) history or evidence of metabolic bone disorders such as hyperthyroidism, parathyroid disease, chronic renal disease, rheumatoid arthritis or 2) history of taking medications affecting calcium and bone turnover such as steroids, thyroid hormone, bisphosphonate, fluorides, calcitonin, and hormonal therapy or 3) history of lumbar spine or hip fracture or 4) previous treatment for osteoporosis or 5) presence of cancer with known metastasis to bone.

The sample size was calculated using the formula to estimating single proportion. The sensitivity of KKOS as 70% from the original study of Pongchaiyakul C et al[5] was used for sample size calculation. When margin of error in estimating the sensitivity was 10% and the prevalence of osteoporosis from the pilot study was 20%, the sample size plus 10% drop out was 445.

The lumbar spine T-score, the femoral neck T-score, total hip T-score, age, height, body weight, age at menopause, year since menopause, family history of osteoporosis, history of any fracture at age > 45 years old, exercise, history of smoking and alcohol drinking were collected and used for analysis.

The OSTA index was calculated from age and weight as 0.2 x (weight – age). The KKOS was calculated from age score plus weight score as shown in the original published study[5]. The cut point ≤ -1 for both OSTA index and KKOS score which classified as high risk for osteoporosis was used to calculate. The ability of OSTA and KKOS to discriminate low BMD as defined by a T-score ≤ -2.5 was evaluated using receiver operating characteristic (ROC) curve analysis, which plots sensitivity against (1-specificity). The area under the curve (AUC), calculated using logistic regression modeling, was used to compare the diagnostic performance of the two tests and to create new cut point of OSTA and KKOS. AUC values > 0.75 are generally considered to represent good performance.

The data were analyzed using SPSS for windows version 17. Descriptive statistics was used to describe demographic characteristics as means, standard deviations (SD) and percent. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) with 95% confidence interval of OSTA index and KKOS score were examined. A ROC curve was generated and the AUC was also inspected. Univariate analysis was performed, using BMD T-score as the dependent variable and each risk factor as the predictor. Only statistically significant ($p < 0.05$) variables were considered in multiple variable analysis. Multiple variable were constructed starting with all significant variables and then removing individual variables one at a time, starting with the variable with the largest p-value, until all remaining variables were statistically significant ($p < 0.05$)

Results

The data of 725 postmenopausal women were obtained and 284 women were excluded. Characteristics

of 441 postmenopausal women are shown in Table 1. Mean age and mean weight were 55.8 years and 56.6 kg respectively. Mean age at menopause was 50 years. Prevalence of osteoporosis of 441 postmenopausal women was 19.7%. Prevalence of osteoporosis was 18.8% for lumbar spine, 2.3% for femoral neck and 2% for total hip.

Using the OSTA index with the original cut point of -1, the sensitivity and specificity in identifying osteoporosis at least one site of femoral neck, total hip or lumbar spine is 51.7% and 77.4% respectively. In high-risk group, 36% of women had osteoporosis, while 13.3% of low risk group had osteoporosis.

KKOS at original cut point of -1 has sensitivity of 56.3% and specificity of 71.8% in identifying at least one of osteoporotic sites. In high-risk group, 32.9% of women had osteoporosis, while 13% of low risk group had osteoporosis.

Table 2 and 3 show the performance of OSTA index and KKOS score in identifying osteoporosis at femoral neck, total hip and lumbar spine. Both OSTA and KKOS have best performance in identifying osteoporosis of femoral neck. The AUC of both OSTA and KKOS at cut point -1 are better than those at cut point zero.

Factors that associated with postmenopausal osteoporosis are shown in Table 4. Age ≥ 65 years,

Table 1. Characteristics of the 441 menopausal women

	n (%)	Range	Mean ± SD
Age (year)		46-84	55.8 ± 5.9
45-54	211 (47.8)		
55-64	199 (45.1)		
≥ 65	31 (7.0)		
Height (cm)		138.5-169.0	153.3 ± 5.3
Body weight (kg)		34.5-89.0	56.6 ± 8.7
Body mass index (kg/cm^2)		16.4-36.8	24.1 ± 3.6
< 18.5	12 (2.7)		
18.5-24.9	272 (61.7)		
25-29.9	134 (30.4)		
≥ 30	23 (5.2)		
Age at menopause		45-58	50.0 ± 3.0
Year since menopause		1-34	5.8 ± 5.6
Osteoporosis (BMD T-score ≤ -2.5)	87 (19.7)		
Osteoporosis of femoral neck	10 (2.3)		
Osteoporosis of total hip	9 (2.0)		
Osteoporosis of lumbar spine	83 (18.8)		

Data were presented in number (%), range, and mean ± SD

Table 2. Distribution of test results for OSTA index and KKOS scoring

Screening result	Total	BMD T-score ≤ -2.5			
		At least one site of osteoporosis	Femoral neck	Total hip	Lumbar spines
OSTA index					
High risk (≤ -1)	125	45 (36.0)	8 (6.4)	7 (5.6)	41 (32.8)
Low risk (> -1)	316	42 (13.3)	2 (0.6)	2 (0.6)	42 (13.3)
Total	441	87 (19.7)	10 (2.3)	9 (2.0)	83 (18.8)
KKOS score					
High risk (≤ -1)	149	49 (32.9)	8 (5.4)	7 (4.7)	45 (30.2)
Low risk (> -1)	292	38 (13.0)	2 (0.7)	2 (0.7)	38 (13.0)
Total	441	87 (19.7)	10 (2.3)	9 (2.0)	83 (18.8)

Data were presented in number (%)

Table 3. Performance of OSTA index and KKOS scoring in identifying osteoporosis in 441 postmenopausal women

	Sensitivity	Specificity	PPV	NPV	AUC
OSTA at cut point -1					
At least one site	51.7% (40.8-62.6)	77.4% (72.7-81.7)	36.0% (27.6-45.1)	86.7% (82.5-90.3)	0.65 (0.59-0.70)
Femoral neck	80.0% (44.4-97.5)	72.9% (68.4-77.0)	6.4% (2.8-12.2)	99.4% (97.7-99.9)	0.76 (0.63-0.90)
Total hip	77.8% (40.0-97.2)	72.7% (68.2-76.8)	5.6% (2.3-11.2)	99.4% (97.7-99.9)	0.75 (0.61-0.90)
Lumbar spine	49.4% (38.2-60.6)	76.5% (71.8-80.8)	32.8% (24.7-41.8)	86.7% (82.5-90.3)	0.63 (0.57-0.69)
KKOS at cut point -1					
At least one site	56.3% (45.3-66.9)	71.8% (66.8-76.4)	32.9% (25.4–41)	87.0% (82.6-90.6)	0.64 (0.58-0.70)
Femoral neck	80.0% (44.4-97.5)	67.3% (62.6-71.7)	5.4% (2.4-10.3)	99.3% (97.5-99.9)	0.74 (0.61-0.87)
Total hip	77.9% (40.0-97.2)	67.1% (62.5-71.5)	4.7% (1.9-9.4)	99.3% (97.5-99.9)	0.73 (0.58-0.87)
Lumbar spine	54.2% (42.9-65.2)	71.0% (65.9-75.6)	30.2% (23.0-38.3)	87.0% (82.6-90.6)	0.63 (0.57-0.69)
OSTA at cut point 0					
At least one site	66.7% (55.7-76.4)	57.1% (51.7-62.3)	27.6% (21.7-34.2)	87.4% (82.5-91.4)	0.62 (0.56-0.68)
Femoral neck	90.0% (55.5-99.7)	53.4% (48.5-58.2)	4.3% (2.0-8.0)	99.6% (97.6–100)	0.72 (0.62-0.82)
Total hip	77.8% (40.0-97.2)	53.0% (48.2-57.8)	3.3% (1.4-6.8)	99.1% (96.9-99.9)	0.65 (0.51-0.8)
Lumbar spine	65.1% (53.8-75.2)	56.4% (51.1-61.6)	25.7% (19.9-32.2)	87.4% (82.5-91.4)	0.61 (0.55-0.67)
KKOS at cut point 0					
At least one site	57.5% (46.4-68.0)	67.2% (62.1-72.1)	30.1% (23.3-37.7)	86.5% (81.9-90.3)	0.62 (0.57-0.68)
Femoral neck	80.0% (44.4-97.5)	63.3% (58.6-67.9)	4.8% (2.1-9.3)	99.3% (97.4-99.9)	0.72 (0.58-0.85)
Total hip	77.8% (40.0-97.2)	63.2% (58.5-67.8)	4.2% (1.7-8.5)	99.3% (97.4-99.9)	0.71 (0.56-0.85)
Lumbar spine	55.4% (44.1-66.3)	66.5% (61.3-71.4)	27.7% (21.1-35.2)	86.5% (81.9-90.3)	0.61 (0.55-0.67)

Data were presented in percent (95% confidence interval)
* PPV = positive predictive value; NPV = negative predictive value; AUC = area under the curve

Table 4. Risk factors of osteoporosis in postmenopausal women

Risk factor	Crude odds ratio			Adjusted odds ratio		
	OR	95% CI	p-value	OR	95% CI	p-value
Age ≥ 65 years	9.3	4.3-20.3	<0.001	9.0	4.0-20.1	<0.001
BMI < 19 kg/m^2	2.3	1.0-5.3	0.049	1.8	0.7-4.6	0.259
Family history of osteoporosis	2.6	1.1-6.2	0.034	2.7	1.1-6.9	0.033
History of fracture at age > 45 years	7.1	2.3-22.2	<0.001	5.3	1.5-18.6	0.009
Exercise	0.9	0.6-1.4	0.662			

OR= odds ratio, BMI=body mass index

family history of osteoporosis and history of fracture at age > 45 years are statistically significant risk factors of osteoporosis in the present study.

Discussion

Osteoporosis is the disease that is common in postmenopausal women and is becoming a health problem in Thailand due to an increase in the elderly population. The prevalence of osteoporosis in the present study is 19.7%, lower than that previously reported in Thai women by Limpaphayom K et al[2]. The reason for this finding is the difference in study participants. The present study recruited the hospital-based participants, while the previous study recruited the community-based participants. Moreover, the populations in the present study are younger than those in Limpaphayom K et al[2]. Comparing to other previous hospital-based studies, the present study has similar prevalence of osteoporosis. Wiriyasirivaj B[7] reported the prevalence of osteoporosis of lumbar spine and hip of 14% and 3.4% respectively in women mean age 54 years who attended the menopause clinic at Vajira Hospital and Chaovisitsaree S et al[8] reported the prevalence of osteoporosis of lumbar spine and hip of 15.2% and 2.5% respectively in women mean age 54.8 years who attended menopause clinic, Chiang Mai

University. In contrast to other studies, Ongartboon P[6] reported lower prevalence of osteoporosis than other studies (5.3% at lumbar spine and 4.8% at the hip). The latter study recruited younger population (aged 35-70) so the prevalence of osteoporosis is lower than other studies.

Osteoporosis increase risk of fracture, effect quality of life, and increase mortality rate. The prospects for the treatment of osteoporosis are significantly less than those for prevention. BMD measurement by DEXA is gold standard for diagnosis of osteoporosis but it is not widely available in Thailand. Therefore, clinical risk indices were developed for identifying women at risk for osteoporosis. Nowadays, there are two clinical risk indices, OSTA index and KKOS scoring system, commonly use in Thailand. The present study demonstrated the ability of OSTA in predicting low BMD being similar to KKOS, as the AUC of the ROC analysis was similar between OSTA and KKOS. The result showed that both indices at cut point -1 had similar performance in sensitivity and specificity to identify postmenopausal osteoporosis. Both indices had higher sensitivity and specificity in identifying subjects with osteoporosis of the hip rather than those with osteoporosis of spines. This finding is consistent with the results of original studies of OSTA index and other previous studies. However, diagnostic performance of KKOS in the present study is lower than that in the original study. Although the sensitivity of both indices is high, both tests had moderate specificity, suggesting that BMD measurements would be required to accurately diagnose osteoporosis

Comparing to the original study of OSTA index[4], the original study had higher sensitivity (91% versus 80%) but lower specificity than this present study (45% versus 72%). The AUC of the present study is comparable to the original study (0.76 versus 0.79). OSTA index had limitation for identifying osteoporosis only at femoral neck, not include lumbar spine, which is a common site of osteoporosis[4]. The performance of OSTA index for identifying osteoporosis in the present study is similar to previous studies that validated the OSTA index in Thai postmenopausal women[7-9].

KKOS, a clinical risk index developed for prediction of osteoporosis in Thai postmenopausal women[5]. Subjects in the original study were in Muang district, Khon Kaen province and majority of them were farmers and house workers. Thus, subjects in OSTA and KKOS were different. KKOS used to identify women at high risk of osteoporosis at femoral neck or lumbar spine. Comparing to the original study of KKOS, this present study found lower sensitivity (56% versus 70%) but similar specificity to the original study. The difference in result may from lower prevalence of osteoporosis in this study and difference of study populations.

The two previous studies comparing OSTA and KKOS in Thai women showed a different result. Ongartboon P[6] found that both indices had comparable performance, high sensitivity, and moderate specificity. Wiriyasirivaj B[7] concluded that OSTA index had more convenient and effective than KKOS for identifying either femoral neck or lumbar spine osteoporosis. The study of Wiriyasirivaj B had lower sensitivity of both indices than the original and this present studies in identifying osteoporosis of femoral neck but similar in sensitivity for lumbar spine and had slightly higher specificity for both indices. However, the AUC that represents the overall performance of this present study is slightly higher than the AUC of Wiriyasirivaj B study. The different results may be from the difference in characteristics of participants. The study of Ongartboon P included all women in the menopause clinic at Phrae Hospital and did not exclude those who had a history of metabolic bone diseases or exposure to any drugs affecting calcium and bone turnover[6]. Participants in Wiriyasirivaj B study were quite similar to those in this present study. Nevertheless, some points that this present study differs from Wiriyasirivaj B study should be noted. Firstly, this study included natural menopause age 45 years or more. Hypogonadism before age 45 is one of the risk factors of osteoporosis and BMD testing should be performed. Thus, clinical risk index is unnecessary in postmenopausal women age less than 45. Secondly, this study excluded those who take hormonal therapy and those who were surgical menopause. These conditions affected bone mass so it is not the real risk for them.

There were three previous studies in Thai women that suggested a change to the cut point of OSTA index to zero[7,9,10]. The performance of OSTA index at cut point zero is shown in Table 3. Changing the cut point of OSTA index to zero increases sensitivity but decreases specificity in detection of high-risk osteoporosis. The AUC of OSTA index at cut point -1 is slightly higher than that at cut point zero.

The same as OSTA index, KKOS at cut point zero had a similar result as cut point -1. The AUC of KKOS at cut point -1 is slightly higher than that at cut point zero. Thus, the authors recommend using the

original cut point of both indices to define Thai women at high risk for osteoporosis.

The present study found many factors affect osteoporosis as shown in Table 4. Age 65 or more, family history of osteoporosis and history of fracture after age 45 years are found to be significant risk factors in this present study. Some known risk factors are not statistically significant in this present study such as low BMI, exercise, smoking, and alcohol intake. The reason is the present study was a retrospective study and inadequate data collection about type and duration of exercise. The women with low BMI is only 2.7% of total population. Only one woman smoked and two women drank alcohol. Thus, data was inadequate for the conclusion of the effect of these risk factors to osteoporosis.

Some limitations of the present study should be noted. This is a retrospective study so some data were collected inadequately. The participants in the present study were postmenopausal women who attended the menopause clinic in the tertiary care center. These women may have menopause related problems or go to check up their health. Thus, attitude, behavior, culture, and occupation of participants may differ from women in general. These findings might not be generalizable to the population with cultural and occupational differences

In conclusion, both clinical risk indices, OSTA and KKOS, had similar results of high sensitivity and moderate specificity in identifying high risk of femoral neck and total hip osteoporosis. However, they had limitation in identifying high risk of lumbar spine osteoporosis that is a common site of osteoporosis and fracture. Thus, the authors recommend using OSTA index for screening because it is more convenient and simpler than the KKOS scoring system.

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Potential conflicts of interest

None.

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การเปรียบเทียบระหว่าง OSTA index และ KKOS scoring system ในการทำนายการเกิดโรคกระดูกพรุนในสตรีวัยหมดระดูที่มารับบริการที่คลินิกสตรีวัยทอง โรงพยาบาลศิริราช

นลินี พาณิชยวัฏ, ประสงค์ ตันมหาสมุทร

วัตถุประสงค์: *ศึกษาเปรียบเทียบความแม่นยำและประสิทธิภาพของ OSTA index และ KKOS scoring system ในการคัดกรองโรคกระดูกพรุนในสตรีวัยหมดระดู และศึกษาถึงปัจจัยเสี่ยงของโรคกระดูกพรุนในสตรีวัยหมดระดูที่มารับบริการที่คลินิกสตรีวัยทอง โรงพยาบาลศิริราช*

รูปแบบการศึกษา: *การศึกษาเชิงพรรณนาแบบการตรวจเพื่อวินิจฉัยโรค*

สถานที่ทำการศึกษา: *คลินิกสตรีวัยทอง โรงพยาบาลศิริราช คณะแพทยศาสตร์ศิริราชพยาบาล กรุงเทพมหานคร ประเทศไทย*

กลุ่มตัวอย่าง: *สตรีวัยหมดระดู จำนวน 441 ราย ที่มารับบริการที่คลินิกสตรีวัยทอง โรงพยาบาลศิริราช และมีผลการตรวจความหนาแน่นของกระดูก ด้วยวิธี DEXA*

วัสดุและวิธีการ: *เก็บรวบรวมข้อมูลผู้ป่วยย้อนหลังจากเวชระเบียนและแบบบันทึกข้อมูลของคลินิกสตรีวัยทอง โรงพยาบาลศิริราช ข้อมูลของสตรีวัยหมดระดูโดยธรรมชาติที่เข้าได้กับเกณฑ์การคัดเข้า และไม่มีเกณฑ์การคัดออกจะถูกรวบรวม และใช้ในการคำนวณ OSTA index และ KKOS score ค่าดัชนีทั้งสองที่จุดตัด ≤ -1 จัดเป็นกลุ่มที่มีความเสี่ยงสูงต่อโรคกระดูกพรุน ทำการเปรียบเทียบความไว ความจำเพาะ ค่าพยากรณ์ผลบวก ค่าพยากรณ์ผลลบ และค่า area under the curve (AUC) ของ OSTA index และ KKOS score และทำการวิเคราะห์ปัจจัยเสี่ยงต่อโรคกระดูกพรุน*

ผลการศึกษา: *ความชุกของโรคกระดูกพรุนเท่ากับร้อยละ 19.7 โดยร้อยละ 2.3 เป็นกระดูกพรุนที่คอกระดูกสะโพกร้อยละ 2 เป็นกระดูกพรุนที่กระดูกสะโพกรวม และร้อยละ 18.8 เป็นกระดูกพรุนที่กระดูกสันหลัง ความไวและความจำเพาะต่อโรคกระดูกพรุนอย่างน้อยหนึ่งแห่งของ OSTA index ที่จุดตัด ≤ -1 เท่ากับร้อยละ 51.7 และ 77.4 ตามลำดับ ความไวและความจำเพาะต่อโรคกระดูกพรุนอย่างน้อยหนึ่งแห่งของ KKOS ที่จุดตัด ≤ -1 เท่ากับร้อยละ 56.3 และ 71.8 ตามลำดับ ความไวต่อโรคกระดูกพรุนที่คอกระดูกสะโพก กระดูกสะโพกรวม และกระดูกสันหลังของ OSTA index เท่ากับร้อยละ 80, 77.8 และ 49.4 ตามลำดับ ความไวต่อโรคกระดูกพรุนที่คอกระดูกสะโพก กระดูกสะโพกรวม และกระดูกสันหลังของ KKOS เท่ากับร้อยละ 80, 77.9 และ 54.2 ตามลำดับ ความจำเพาะต่อโรคกระดูกพรุนของ KKOS ต่ำกว่า OSTA index เล็กน้อย อายุมากกว่า 65 ปี ประวัติโรคกระดูกพรุนในครอบครัว และประวัติกระดูกหักหลังอายุ 45 ปี เป็นปัจจัยเสี่ยงต่อโรคกระดูกพรุน โดยมีค่า odds ratio เท่ากับ 9.0, 2.7 และ 5.3 ตามลำดับ*

สรุป: *ทั้ง OSTA index และ KKOS scoring system มีประสิทธิภาพดีในการตรวจคัดกรองโรคกระดูกพรุนที่กระดูกสะโพก แต่มีความไวต่อโรคกระดูกพรุนที่กระดูกสันหลังต่ำ แนะนำให้ใช้ OSTA index ในการคัดกรองโรคกระดูกพรุน เนื่องจากมีประสิทธิภาพใกล้เคียงกัน และ OSTA index เป็นวิธีที่สะดวกและคำนวณได้ง่ายกว่า KKOS scoring system*