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## GYNAECOLOGY

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# Validation of FRAX® WHO Fracture Risk Assessment Tool with and without the Alara Metriscan Phalangeal Densitometer as a Screening Tool to Identify Osteoporosis in Thai Postmenopausal Women

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## ABSTRACT

**Objective:** To compare the performance of the WHO fracture risk assessment FRAX® tool and Alara Metriscan for screening osteoporosis in elderly Thai women using spine and hip BMD measurement by DXA.

**Materials and Methods:** This study included postmenopausal Thai women, aged between 50 and 90 years, who came to check for osteoporosis at Banpho Hospital. Those met at least one of the criteria for routine axial densitometry according to the Thai Osteoporosis Foundation (TOPF) were recruited. The correlation between the FRAX® tool and Alara Metriscan, or FRAX® tool combined with Alara Metriscan classification and the actual BMD-based classification (by DXA) are summarized. Receiver operating characteristic (ROC) curves were constructed for FRAX® tool and Alara Metriscan.

**Results:** This study included 438 postmenopausal Thai women, of whom 122 (27.9%) had osteoporosis. The mean $\pm$ SD of age, body mass index were 66.4 $\pm$ 10.6 years, 23.3 $\pm$ 3.5 kg/m<sup>2</sup>, respectively. The sensitivity of FRAX® and Alara Metriscan to identify osteoporosis were high (83.6% and 96.7% respectively) but the specificity (72.1%) and PPV (53.6%) of FRAX® were better. However, there is no difference in the AUCs Standard error (SE) of FRAX® (0.857(0.021)) and the AUCs (SE) of Alara metriscan (0.861(0.019)). The combination of FRAX® and Alara Metriscan had lower sensitivity (81.9%) but high specificity (79.4%) to identify women with osteoporosis. When combined FRAX® with Alara Metriscan the LR+ was 3.98 (95%CI :3.16-5.03) and LR- was 0.23 (95%CI:0.15-0.33).

**Conclusions:** FRAX® WHO Fracture Risk Assessment Tool and Alara Metriscan may be helpful to identify women at risk of osteoporosis. Combination of both tools were significantly improve the screening of osteoporosis in postmenopausal Thai women.

**Keywords:** postmenopausal osteoporosis, FRAX, radiographic absorptiometry, bone density, alara metriscan

## Introduction

The prevalence of osteoporosis in the Thai population was 19.8-24.7% and 13.6-19.3% at the lumbar spine and femoral neck, respectively. The incidence of hip fracture for age-adjusted rates (per 100,000) was 289 in women while the mortality rate after hip fracture during hospitalization was 12% per year<sup>(1)</sup>. Early recognition and management for those who may have risk for fractures will be beneficial for postmenopausal women.

Osteoporosis is diagnosed by bone mineral density (BMD) measurements. BMD measurements with dual X-ray absorptiometry (DXA) can be used to estimate the bone density in the central skeletal sites such as hip or spine. Central DXA has become the gold standard for the assessment of osteoporosis<sup>(2)</sup>. While central DXA is generally a good predictor of fracture risk, the machines are typically large, expensive, and required a trained operator. In addition, it is time consuming and is not suitable for the primary care setting. Therefore, osteoporosis screening with DXA is not recommended because of its cost-beneficial<sup>(3,4)</sup>.

DXA is suitable for diagnosis of osteoporosis, not for the screening. Large numbers of potential patients can be reached by questionnaire-based methods. Various questionnaire-based systems have been created to produce a cost-effective method osteoporosis screening. Questionnaires ask about clinical risk factors for osteoporosis and convert the answer to the quantitative scores. The scores are designed to give information on those patients at risk of having low bone mineral density, and those who need to undergo a full assessment of their bone status.

Questionnaires currently used are the Osteoporosis Self-assessment Tool (OST, OSTA), Osteoporosis Risk Assessment Instrument (ORAI), Simple Calculated Osteoporosis Risk Estimation (SCORE), Osteoporosis Index of Risk (OSIRIS), the risk index derived using data from the study of osteoporotic fractures (SOFSURF)<sup>(5)</sup>. OSTA index or KKOS is suggested by Thai Osteoporosis Foundation (TOPF) because of its low cost<sup>(6)</sup>. Although OSTA index or KKOS scoring system has very high sensitivity

for screening osteoporosis, the specificity and positive predictive value are low. This index may not be sufficient to diagnose but may be enough as a screening tool for osteoporosis<sup>(7)</sup>.

In 2008, the World Health Organization (WHO) have focused on developing a risk assessment tool (FRAX<sup>®</sup>) using clinical risk factors with and without femoral neck BMD to enhance fracture prediction<sup>(8)</sup>. It is calculated on the basis of several large long-term prospective cohort studies and is available to be accessed (<http://www.shef.ac.uk/FRAX>)<sup>(9)</sup>. The FRAX<sup>®</sup> algorithm is correlated with ethnics using clinical risk factors with or without femoral neck BMD measurement, to calculate an individual's 10-year probability of hip fracture and 10-year probability of major osteoporotic (hip, clinical vertebral, wrist, humerus) fracture. The development of the FRAX<sup>®</sup> tool has been supported by organizations, including the International Osteoporosis Foundation (IOF) and the National Osteoporosis Foundation (NOF) in the United States. Based on the results of a U.S. -specific cost-effective analyses<sup>(10)</sup>, NOF recently modified its treatment guidelines to recommend pharmacologic therapy for adults aged 50 years and older meeting specific criteria, including osteopenia (BMD T score between -1 to -2.5) and 10-year absolute probability of hip (3% or higher) or major osteoporotic (20% or higher) fractures as calculated by the FRAX<sup>®</sup> tool<sup>(11)</sup>.

Radiographic absorptiometry (RA) (Alara Metriscan, Hayward, Calif., USA) is the modern-day descendent of radiographic photodensitometry<sup>(12)</sup>. The ability to digitize and to perform computerized analysis of high-resolution radiographic images reduce errors comparing with radiographic exposure techniques and overlying soft tissue thickness. The accuracy of RA for assessment of bone mineral content of the middle phalanges was at 4.8% with total clinical precision error of 1.1%<sup>(13)</sup>. The ability to predict bone density at other skeletal sites from hand radiographic absorptiometry is as good as other techniques such as single-photon absorptiometry, dual-photon absorptiometry, dual-energy X-ray absorptiometry, or quantitative computed tomography of the spine<sup>(14)</sup>. However, RA hand cannot

be used to predict bone density at other skeletal sites.

To our knowledge, there is no data of for FRAX® and Alara Metriscan measurement in Thai population. The primary objective of this study was to compare the value of the WHO fracture risk assessment FRAX® tool and Alara Metriscan in discriminating osteoporosis in elderly Thai women(as defined by DXA-determined BMD). We also investigated whether WHO fracture risk assessment FRAX® tool can be used together with Alara Metriscan.

## Materials and Methods

### Settings and Subjects

The present study was designed as a cross sectional investigation of 438 postmenopausal women (defined by cessation of normal menstruation for at least 1 year) (October 2010 and September 2011) who came to evaluate the possibility of osteoporosis (without known diagnosis of osteoporosis or terminal illness) at Banpho Hospital, Banpho, Chachoengsao, Thailand. All women are Thai , aged between 50 and 90 years old. Subjects met at least one of the criteria for routine axial densitometry from the Thai Osteoporosis Foundation (TOPF)<sup>(6)</sup>. The exclusion criteria were history of metabolic bone disorders (other than postmenopausal bone loss), presence of cancer(s) with known metastasis to bone, history of previous hip fracture, history of hip or knee prosthesis, abnormal features of bone at the non-dominant hand on physical examination. The present study was approved by the Ethics Committee of Chachoengsao Hospital and the informed consent was obtained from all participants.

### Measurements

Participants were assigned to see and to be interviewed by trained research nurse. Body weight (including light indoor clothing) was measured using an electronic balance scale (accuracy 0.1 kg) and standing height (without shoes) was measured by a stadiometer (nearest 0.1 cm). Participants were asked to fill in the questionnaire, consisting of 7 questions regarding risk factors for osteoporosis according to FRAX® (accessed for via the University of Sheffield website). Subjects

were then examined by both Alara Metriscan and DXA of the lumbar spine (vertebrae L1–L4), femoral neck and the total hip regions.

### FRAX®

The WHO Fracture Risk Assessment Tool (FRAX®) web version 3.4 can be accessed through the University of Sheffield website (<http://www.shef.ac.uk/FRAX>). This evaluation results in nine important risk factors including age, weight, height, previous fragility fracture, parental hip fracture, current smoking, regular intake of 3 or more units of alcohol daily, rheumatoid arthritis, oral glucocorticoids (current therapy or former exposure to glucocorticoids) as well as, alternatively, causes of secondary osteoporosis or femoral BMD. The FRAX® algorithm is country specific and uses clinical risk factors, without consideration of femoral neck BMD measurement. This information and risk factors are identified and estimated in a complete program calculated into a 10-year probability of hip fracture and 10-year probability of major osteoporotic (hip, clinical vertebral, wrist, or humerus) fracture.

As there are currently no data of Thai population for FRAX® measurement, the Thai Osteoporosis Foundation (TOF) has initially studied and tested FRAX®. Data have shown that it is appropriate to use FRAX® with Asian population including Japan and Thai. WHO does not make recommendation for intervention since it depends on various factors. WHO has suggested that treatment should be determined by each country, based on the local healthcare policy and cost-effectiveness for the treatment of osteoporosis. Intervention guidelines have been set in UK, USA and Sweden<sup>(9,10)</sup>.

Criteria suggested by the Thai Osteoporosis Foundation (TOF) can be used in women with a 10-year probability for hip fracture of 3% or more or a 10-year probability for other major osteoporotic fractures of 20% or more for therapeutic intervention<sup>(6)</sup>. However, women with a 10-year probability for hip fracture of 3% or more or a 10-year probability for other major osteoporotic fractures of 20% or more are classified as “high risk” and otherwise, a “low risk” as a screening

tool for the identify high-risk candidates for developing intervention guidelines.

#### **The Alara Metriscan phalangeal densitometer**

A compact digital radiographic absorptiometry (RA) device is used to determine the phalangeal bone mineral density of the middle phalanges of the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> digits of the non-dominant hand. This technique uses a self-contained single energy (60 kV) X-ray system (Alara Metriscan, Hayward, Calif., USA). The images are recorded on phosphor plate which is scanned to extract the image. The hand radiograph is corrected according to a record reference image startup. An aluminium wedge contained in the image is used as an image positioning reference. The segmented of soft tissue and bone were analysed in separate components. The ROIs are automatically identified and outlined. Density is estimated in the three phalanges and expressed in arbitrary units (mineral mass/area). T-scores were expressed using local reference data. Woman with radiographic absorptiometry (RA) test measurement was expressed in T-score. The value below -2.5 was considered as "high risk". The patient X-ray exposure is less than 0.012  $\mu$ Sv per examination. The total clinical precision error was 1.1%.

#### **Dual-energy X-ray absorptiometry (DXA)**

Areal bone density was measured by Lunar DPX NT, the direct-digital narrow-angle fan beam system (GE Healthcare, Madison, Wisconsin, USA), by specially trained and certified technicians. The BMD measurement was expressed in T-scores based on the National Health and Nutrition Examination (NHANES III) database at the lumbar spine (vertebrae L1–L4) hip and were used as gold standard. For the purpose of this analysis, osteoporosis (the outcome measure) was defined as a T-score below -2.5 at the spine and/or femoral neck and/or hip. It has precision error of PA spine 1.0%, proximal femur 1.0% and Dual FemurTM < 1.0%.

#### **Statistical analysis**

Descriptive statistics were used to describe study subjects' characteristics. In this study, BMD from

DXA was used as a gold standard. Each woman was classified as having "osteoporosis" if her BMD T-score was equal to or less than -2.5. Otherwise these women was classified as "non-osteoporosis". The differences in age, body weight, height and body mass index (BMI) between the two groups were analyzed by t-test. The correlation between the FRAX® tool, Alara Metriscan, FRAX® tool combined with Alara Metriscan and the actual BMD-based classification (by DXA) were summarized by a 2x2 table. Osteoporosis was defined as a T-score below -2.5 at the spine and/or hip. Receiver operating characteristic (ROC) curves were constructed by calculating the specificity and sensitivity of FRAX® tool and Alara Metriscan at different cut point values in discriminating osteoporosis (as defined by DXA-determined BMD). Areas under the curves (AUCs) were computed. Sensitivity was defined as the proportion of subjects with osteoporosis who had a positive FRAX® tool or Alara Metriscan test. Specificity was defined as the proportion of subjects without osteoporosis who had a negative FRAX® tool or Alara Metriscan test. For each test, the positive predictive value (PPV) was calculated as true positive (positive test and osteoporosis) divided by the number of subjects with a positive test. The negative predictive value (NPV) was calculated as true negative (negative test and without osteoporosis) divided by the number of subjects with a negative test. All statistical analyses were conducted with the use of SPSS16.0 for Windows and MedCalc® version 12.1.0.0. Reported p-values are two-sided. The nominal significance level was set at  $p < 0.05$ .

## **Results**

### **Subject characteristics**

The study population consisted of 438 postmenopausal Thai women, aged between 50 and 90 years. One hundred twenty two of them (27.9%) had osteoporosis. The mean $\pm$ SD of age, body weight, height and body mass index were  $66.4\pm10.6$  years,  $55.2\pm9.0$  kg,  $153.6\pm5.9$  cm. and  $23.3\pm3.5$  kg/m<sup>2</sup>, respectively. The women with osteoporosis were older with significantly lower weight, height and body mass index (BMI) (Table 1).

**Table 1.** Demographic characteristics of study subjects and results of the DXA measurements

Variable	Population	Osteoporosis	Non-osteoporosis	p
N	438(100%)	122 (27.9%)	316 (72.1%)	
Age (years)	66.4(10.6)	73.7 (9.1)	63.6(9.8)	<0.001
Weight(kg)	55.2(9.0)	49.5 (8.0)	57.4(8.4)	<0.001
Height(cm)	153.6(5.9)	151.0 (6.1)	154.6 (5.5)	<0.001
Body mass index (kg/m <sup>2</sup> )	23.3(3.5)	21.7 (3.3)	24.0 (3.3)	<0.001

Abbr: DXA, dual-energy X-ray absorptiometry, Values are mean ( $\pm$ SD).

**Table 2.** Prevalence of osteoporosis and non-osteoporosis by dual energy X-Ray BMD and risk category

Risk category	Population (n=438)	Osteoporosis (n=122)	Non-osteoporosis (n=316)
FRAX®			
High-risk	190 (43.4%)	102 (23.3%)	88 (20.1%)
Low-risk	248 (56.6%)	20 (4.6%)	228 (52.1%)
Alara Metriscan			
High-risk	271 (61.9%)	118 (26.9%)	153 (34.9%)
Low-risk	167 (38.1%)	4 (0.9%)	163 (37.2%)
FRAX® & Alara Metriscan			
High-risk	165 (37.7%)	100 (22.8%)	65 (14.8%)
Low-risk	273 (62.3%)	22 (5.0%)	251 (57.3%)

FRAX® tool showed that 43.4% of women presented as “high risk” while 56.6% of them were “low risk” of osteoporosis. Alara Metriscan showed that 61.9% of these women were “high risk” while 38.1% of them were “low risk” of osteoporosis. FRAX® tool combined with Alara Metriscan demonstrated that 37.7% of these women were “high risk” and 62.3% of them were “low risk.” (Table 2).

Comparing FRAX® or Alara Metriscan alone with DXA, the sensitivity of FRAX® and Alara Metriscan in identifying osteoporosis were high (83.6% and 96.7% for FRAX® and Alara Metriscan respectively) but the specificity of FRAX® and Alara Metriscan were average (72.1% and 51.5%, respectively) (Table 3).

However, the PPV, NPV of them were comparable. Both tests had low PPV (53.6, 43.5% for FRAX® and

Alara Metriscan, respectively) but high NPV (91.9, 97.6%) (Table 3).

The Receiver operating characteristic (ROC) curves for identifying women with osteoporosis is shown in Fig.1. The Hip Fracture (Hip Fx) and Major Osteoporotic Fracture (Major Fx) ROC curves demonstrated the AUCs (SE) of 0.857 (0.021) and 0.854 (0.021), respectively whereas the Alara metriscan curve was 0.861(0.019). The AUC difference of hip fracture (hip Fx) and Alara metriscan had no different ( $p = 0.85$ ). Similar trends were hip Fx observed when analyzing the AUC difference between major osteoporotic fracture (Major Fx) and Alara metriscan ( $p=0.77$ ).

Combination of FRAX® with Alara Metriscan demonstrated reduction of sensitivity (81.9%) to identify osteoporosis but increase specificity (79.4%) and

PPV(60.6%). There was on NPV.

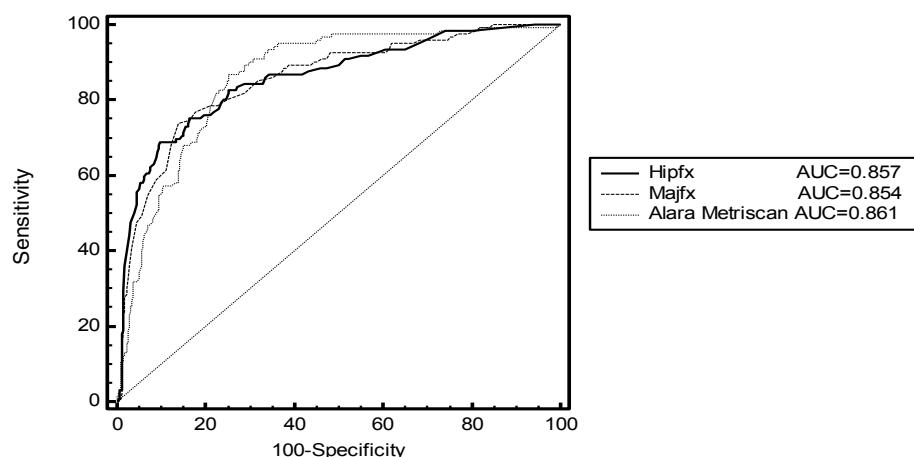
Good diagnostic test should have LR+ and LR- around 10, 0.1 while very good strength should be 5, 0.2 and average strength is 2, 0.5 Our results

demonstrated good strength for the combination of FRAX® and Alara Metriscan (LR+ was 3.98 (95%CI :3.16-5.03) and LR- was 0.23 (95%CI :0.15-0.33)).

**Table 3.** Diagnostic performance of FRAX® tool, Alara Metriscan and FRAX® tool with Alara Metriscan to define osteoporosis using the standard assessment by dual energy X-rays BMD

Tools	Sensitivity %	Specificity%	PPV %	NPV%	LR+	LR-
	(95%CI)	(95%CI)	(95%CI)	(95%CI)	(95%CI)	(95%CI)
FRAX®	83.6 (75.8-89.6)	72.1 (66.8-77.0)	53.6 (46.3-60.9)	91.9 (87.8-95.0)	3.00 (2.47-3.65)	0.23 (0.15-0.34)
Alara Metriscan	96.7 (91.8-99.1)	51.5 (45.9-57.2)	43.5 (37.5-49.6)	97.6 (93.9-99.3)	2.00 (1.77-2.25)	0.06 (0.02-0.17)
FRAX® &	81.9 (73.9-88.3)	79.4 (74.5-83.7)	60.6 (52.7-68.1)	91.9 (88.0-94.8)	3.98 (3.16-5.03)	0.23 (0.15-0.33)

Abbr: PPV, positive predictive value ; NPV, negative predictive value ; LR+, positive likelihood ratio ; LR-, negative likelihood ratio.



Hip Fx                    AUC (SE) : 0.857(0.021), 95%CI (0.820-0.888)

Major Fx                    AUC (SE) : 0.854(0.021), 95%CI (0.818-0.886)

Alara metriscan    AUC (SE) : 0.861(0.019), 95%CI (0.825-0.892)

AUC = Area under curve, SE = Standard error

**Fig 1.** Receiver operating characteristic (ROC) curves for Prediction of Hip Fracture (Hip Fx), Major Osteoporotic Fracture (Major Fx), and Alara metriscan to screen for osteoporosis at the spine or hip for all subjects.

## Discussion

Fractures related to osteoporosis are a major health issue and produce a significant economic and social burden in Asian countries. In 2001, the Asian Osteoporosis Study (AOS), a multi-national research survey, investigated the incidence of hip fracture in Thailand. The age-adjusted rates (per 100,000) were 114 and 289 in men and women, respectively<sup>(15)</sup>. Osteoporotic fractures, particularly hip fractures, are associated with chronic pain and disability, loss of independence, decreased quality of life, and increased mortality. In Thailand, the mortality rate after hip fracture during hospitalization was 12% per year<sup>(16)</sup>. Early recognition and management of individuals who may be susceptible to fractures provides a substantial benefit by reducing the burden of fractures.

A number of questionnaire-based systems have been revised in an attempt to produce a cost-effective method of screening for osteoporosis. Risk assessment questionnaires have been published by the NOF and the International Osteoporosis Foundation. However, none of them has been subjected to rigorous development and validation processes. In contrast to these risk assessment tools, several screening instruments have been constructed and tested. Validated instruments have varying complexity, but similar sensitivity and specificity for identifying individuals at risk. The area under the receiver operating characteristic curve was between 0.75 (SOFSURF) and 0.81(SCORE).

The simplest tool (OST), uses only age and weight, demonstrates an AUC of 0.79<sup>(17)</sup>. These risk assessment tools are developed for European and American (Caucasian) population which have different size, lifestyle, food and environmental from Asians population. Therefore, Osteoporosis Self-assessment Tools for Asian (OSTA) have been developed and more popular for Asian people. In Thailand, OSTA index has high sensitivity (88-93%) and specificity (45-61%). The ROC curves are range from 0.74 to 0.76<sup>(18,19)</sup>. Currently, there is no accurate risk assessment tools for elderly women.

Our results showed that FRAX® tool measurement was good. However, the U.S. Preventive Services Task

Force AUC estimates for FRAX® ranged from 0.54 to 0.78 for osteoporotic fractures and 0.65 to 0.81 for hip fractures<sup>(20)</sup>. The same as Kristine E, et al<sup>(21)</sup> and Florence A, et al<sup>(22)</sup> studies compared FRAX® with simple models, such as age and BMD or age and fracture history, showed that simple models are as good as FRAX® in predicting 10-year risk of hip and major osteoporotic fracture.

This study showed that Alara metriscan had a highest sensitivity (96.7%) and NPV (97.6%), but lowest specificity (51.5%) and PPV (43.5%). The Alara metriscan ROC curve was characterized by AUC of 0.861 (0.019), similar Boonen et al<sup>(23)</sup>.

Postmenopausal Belgian women were tested with QUS of the calcaneus, DXR of the metacarpals of the hand, RA of the phalanges, and DXA of the lumbar spine and total hip. These results demonstrated that phalangeal RA was the most accurate of various peripheral techniques for central DXA. The sensitivity for identifying women with osteoporosis was 77% using DXR and 83% using RA. The DXR and RA curves were characterized by AUCs of 0.84 and 0.80, respectively. These suggest that phalangeal RA may be at least as effective as pre-screening methods for targeting DXA testing in high-risk postmenopausal women. These results contradict with study from Radiological Associates of Sacramento, CA<sup>(24)</sup>. Preliminary results indicate that the cutoff T-score of MetriScan at -2.5 give the sensitivity and specificity of the lumbar spine (L2-L4) and hip (Total Hip) at 52.5%, 90.5% and 61.8%, 89.9%, respectively.

Evidence showed that FRAX® combined with Radiographic absorptiometry (RA) of phalanges (Alara, MetriScan) for osteoporosis screening in postmenopausal women has never been studied for their accuracy. Kung et al<sup>(25)</sup> assessed the combination of quantitative bone ultrasound (QUS) and the OST index in postmenopausal Asiatic women. They proposed a cutoff for the densitometry of a T-score at  $\leq -2.35$  and an OSTA at  $\leq -1$ . The sensitivity increases from 79% to 91%, but specificity decreases from 59% to 44%.

Pongchaiyakul C, et al<sup>(26)</sup> compared the

Osteoporosis Self-assessment Tool for Asians (OSTA), KKOS score and quantitative bone ultrasound (QUS) in identifying subjects with low BMD by DXA in Thai women. QUS was measured by Achilles+ (GE Lunar, Madison, WI, USA) and converted to T-score. The OSTA and KKOS score was calculated for each woman using her age and weight. Women with OSTA/KKOS scores  $< -1$  and  $> -1$  were classified as "high risk" and "low risk", respectively. The sensitivity of QUS was lower than the sensitivity of OSTA/KKOS (60 vs. 71/74%) but the specificity and PPV of QUS were higher than OSTA/KKOS. The sensitivity increased when using OSTA/KKOS combined with QUS to identify osteoporosis (~87-89%) while the specificity, PPV and NPV were comparable with using clinical risk indices alone.

This study found that FRAX® combined with Alara Metriscan reduced the sensitivity to 81.9%, but increased specificity to 79.4%. The negative predictive value (NPV) at 91.9% allows for the exclusion of healthy women. This will reduce unnecessary bone density examinations in lowest risk population. A good screening tools must have a high sensitivity in order to include most of the cases. The FRAX® would recommend BMD testing in 46.3% of women without osteoporosis, whereas the Alara Metriscan would suggest testing in 56.4% of women without osteoporosis.

The National Osteoporosis Foundation (NOF) guidelines were the least specific. It suggests BMD testing in 90% of women without osteoporosis. However, we used FRAX® with Alara Metriscan suggest BMD testing only 39.3%. These women must be confirmed by BMD testing before receiving treatment. So FRAX® tool and Alara Metriscan do not need to have both high sensitive and high specificity. There is no harm for unnecessary treatment or invasive diagnosis testing in case of a false positive.

A major strength of this study was the high risk approach which is more reliable than other forms. The measurement of BMD in the present study was based on the DXA instrument, which is considered to be one of the most accurate and valid methods of measurement. This is the first report using FRAX® WHO Fracture

Risk Assessment Tool and the Alara Metriscan as a screening tool for identification osteoporosis in Thai postmenopausal women.

Limitations of the study was the small sample size. The subjects have a selection bias among participants as a group of government officials, levels of education, lifestyles, cultural backgrounds and environmental living conditions. All subjects met at least one of the criteria for routine axial densitometry were consistent with those of the Thai Osteoporosis Foundation (TOPF). They are not a random sample of the population and have higher prevalence of osteoporosis than the general population. Thus, the future should be conducted in a larger sample sized.

## Conclusion

Using FRAX® WHO Fracture Risk Assessment Tool and the Alara Metriscan can help target BMD measurements to women at risk for osteoporosis. Combination of the FRAX® risk assessment tool and Alara Metriscan were significantly improve screening for osteoporosis. This approach could be used in a primary care setting or community-based hospital as a first-line in postmenopausal women where an axial DEXA is not available.

## References

1. Pongchayakul C, Songpattanasilp T, Taechakraichana N. Burden of Osteoporosis in Thailand. *J Med Assoc Thai* 2008; 91: 261-7.
2. World Health Organization. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. No. 843 of Technical Reports Series. Geneva: 1994.
3. National Osteoporosis Foundation. Physician's guide to prevention and treatment of osteoporosis 2003. Available at: <http://www.nof.org/>. Accessed June 25, 2006.
4. Richy F, Ethgen O, Bruyere O, Mawet A, Reginster JY. Primary prevention of osteoporosis mass screening scenario or prescreening with questionnaires? an economic perspective. *J Bone Miner Res* 2004; 19: 1955-60.
5. Cook RB, Collins D, Tucker J, et al. Comparison of questionnaire and quantitative ultrasound techniques as screening tools for DXA. *Osteoporos Int* 2005; 16: 1565-75.
6. Thai Osteoporosis Foundation (TOPF). Clinical practice guideline of Osteoporosis 2010. Available at: <http://>

thaiosteoporosis.org/pages/guideline/. Accessed March 20,2010.

7. Pongchaiyakul C, Nguyen ND, Pongchaiyakul C, Nguyen TV. Development and validation of a new clinical risk index for prediction of osteoporosis.in Thai women. *J Med Assoc Thai* 2004;87:910-6.
8. Kanis JA, Oden A, Johnell O, Johansson H, De Laet C, Brown J, et al. The use of clinical risk factors enhances the performance of BMD in the prediction of hip and osteoporotic fractures in men and women. *Osteoporos Int.* 2007;18:1033-46.
9. FRAX® WHO fracture risk assessment tool [8-13-2008]. <http://www.shef.ac.uk/FRAX/>
10. Tosteson AN, Melton LJ, III, Dawson-Hughes B, et al. Cost-effective osteoporosis treatment thresholds: the United States perspective. *Osteoporos Int.* 2008;19:437-447.
11. National Osteoporosis Foundation Clinician's Guide to Prevention and Treatment of Osteoporosis. [2-7-2009].
12. Yates AJ, Ross PD, Lydick E, Epstein RS. Radiographic absorptiometry in the diagnosis of osteoporosis. *Am J Med* 1995;98:41S-47S.
13. Yang S, Hagiwara S, Engelke K, et al. Radiographic absorptiometry for bone mineral measurement of the phalanges: precision and accuracy study. *Radiology* 1994;192:857-859.
14. Kleerekoper M, Nelson DA, Flynn MJ, Pawluszka AS, Jacobsen G, Peterson EL. Comparison of radiographic absorptiometry with dual-energy X-ray absorptiometry and quantitative computed tomography in normal older white and black women. *J Bone Miner Res* 1994;9:1745-1749.
15. Lau EMC, Lee JK, Suriwongpaisal P, Saw SM, Das De S, Khir A, et al. The Incidence of Hip Fracture in Four Asian Countries:The Asian Osteoporosis Study (AOS). *Osteoporos Int* 2001;12:239-43.
16. Chariyalertsak S, Suriyawongpisal P, Thakkinstain A. Mortality after hip fractures in Thailand. *Int Orthop* 2001; 25: 294-7.
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.
18. Gourlay ML, Miller WC, Richy F, Garrett JM, Hanson LC, Reginster JY. Performance of osteoporosis risk assessment tools in postmenopausal. *Osteoporos Int* 2005;16:921-7.
19. 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.
20. Nelson HD, Haney EM, Dana T, Bougatsos C, Chou R. Screening for osteoporosis: an update for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2010;153:99-111.
21. Ensrud KE, Ewing SK, Taylor BC et al. A Comparison of Prediction Models for Fractures in Older Women Is More Better? *Arch Intern Med.* 2009;169:2087-2094.
22. Trémollieres FA, Pouillès JM, Drewniak N, Laparra J, Ribot CA, Dargent-Molina P. Fracture risk prediction using BMD and clinical risk factors in early postmenopausal women: sensitivity of the WHO FRAX tool. *J Bone Miner Res.* 2010;25:1002-9.
23. Boonen S, Nijs J, Peeters H, et al. Identifying postmenopausal women with osteoporosis by calcaneal ultrasound, metacarpal digital X-ray radiogrammetry and phalangeal radiographic absorptiometry: a comparative study. *Osteoporos Int* 2005;16:93-100
24. Mitchell CR, Myers RW, King DM, Steven M. Phalangeal radiographic absorptiometry : an effective method for osteoporosis screening. *Poster Abstracts: Osteoporosis - Diagnosis. Abstract presented at Sixth International Symposium on Osteoporosis, National Osteoporosis Foundation, Washington DC, 7 April 2005.*
25. Kung AWC, Ho AYY, Ben Sedrine W, et al. Comparison of a simple clinical risk index and quantitative bone ultrasound for identifying women at increased risk of osteoporosis. *Osteoporos Int.* 2003;14:716-21.
26. Pongchaiyakul C, Panichkul S, Songpatanasilp T. Combined clinical risk indices with quantitative ultrasound calcaneus measurement for identifying osteoporosis in Thai postmenopausal women. *J Med Assoc Thai* 2007; 90: 2016-23.

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## การทดสอบเครื่องมือประเมินความเสี่ยงของการเกิดกระดูกหัก FRAX® ขององค์กรอนามัยโลก ร่วมกับใช้และไม่ใช้เครื่องมือ Alara Metriscan phalangeal densitometer ในการคัดกรองโรคกระดูกพรุนในสตรีไทยวัยหมดประจำเดือน

สุรกิจ อิงยืนยง

**วัตถุประสงค์:** เพื่อทดสอบและเปรียบเทียบค่าความสามารถของเครื่องมือ FRAX® กับเครื่อง Alara Metriscan ในการคัดกรองโรคกระดูกพรุนในสตรีไทยวัยหมดประจำเดือน โดยการวัดค่า BMD ของกระดูกสันหลังและสะโพกโดยการใช้ DXA เป็น gold standard

**วัสดุและวิธีการ:** ศึกษาในอาสาสมัครไทยวัยหมดประจำเดือนที่มาตรวจรักษาแผนผู้ป่วยนอก โรงพยาบาลบ้านโพธิ์ มีอายุระหว่าง 50 และ 90 ปี ผ่านเกณฑ์ในการส่งตรวจ วัดความหนาแน่นกระดูก BMD ของมุนนิธิโรคกระดูกพรุนไทย (TOPF) วิเคราะห์ข้อมูลทั่วไปด้วยสถิติเชิงพรรณนา เปรียบเทียบผล FRAX® และค่า T-score ของ Alara Metriscan ในการระบุกลุ่มเสี่ยงต่อการเป็นโรคกระดูกพรุน แบล็คผลลัพธ์ในตาราง  $2 \times 2$  เพื่อคำนวนค่าROC ความสามารถในการวินิจฉัย และพื้นที่ที่อยู่ภายใต้เส้นโค้ง (AUCs)

**ผลการวิจัย:** อาสาสมัครไทยวัยหมดประจำเดือน 438 ราย มีอายุเฉลี่ย 66.4 ปี ส่วนใหญ่มีอายุ 70-79 ปี (ร้อยละ 44.3) และค่าROC มีค่าเฉลี่ย  $23.3 \text{ kg/m}^2$  พบรความซูกของโรคกระดูกพรุนร้อยละ 27.9 (122 ราย) การศึกษาคัดกรองโดยใช้เครื่องมือ FRAX® และเครื่องมือ Alara Metriscan พบร่วมมีความไวสูงใกล้เคียงกัน ร้อยละ 83.6 และ 96.7 ตามลำดับ แต่ ความจำเพาะ (ร้อยละ 72.1) และค่าพยากรณ์บวก (ร้อยละ 53.6%) ของเครื่องมือ FRAX® มากกว่า แต่เมื่อนำไปทดสอบประสิทธิภาพโดย ROC curves พบร่วมไม่แตกต่างกันอย่างมีนัยสำคัญ โดยมีค่า AUCs (SE) ของเครื่องมือ FRAX® ได้ 0.85 (0.021) และเครื่องมือ Alara Metriscan ได้ 0.861 (0.019) การศึกษานี้พบว่า ถ้านำเครื่องมือ FRAX® กับเครื่อง Alara Metriscan มาใช้ร่วมกันในการคัดกรอง ค่าความไวลดลง (ร้อยละ 81.9) ความจำเพาะเพิ่มขึ้น (ร้อยละ 79.4) แต่ประสิทธิภาพเพิ่มขึ้นอยู่ในเกณฑ์มาก โดยมีค่า LR+ 3.98 (95%CI: 3.16-5.03) และค่า LR- 0.23 (95%CI : 0.15-0.33)

**สรุป:** การใช้เครื่องมือ FRAX® ร่วมกับเครื่อง Alara Metriscan สามารถช่วยการวัด target BMD เพื่อค้นหาโรคหูงี่ที่มีความเสี่ยงต่อโรคกระดูกพรุน และหากนำมาใช้ร่วมกันจะช่วยเพิ่มความถูกต้องในการคัดกรองผู้ป่วยโรคกระดูกพรุนในสตรีไทยวัยหมดประจำเดือน ได้อย่างมีนัยสำคัญ

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