Original Article

Clinical osteoporosis probability scoring system: Selection of menopausal women for bone densitometry screening

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ABSTRACT

Objectives: To formulate a clinical scoring system for evaluating people at risk of osteoporosis before ordering Bone Mass Densitometry.

Methodology: Eighty two probable clinical osteoporosis related factors were checked in 325 females referred for Bone Mass Densitometry testing in Hamadan province, Iran. The statistical modeling resulted in a clinical osteoporosis probability (COP) scoring system based on 9 factors including: fracture history, drug therapy with thyroid hormone, corticosteroids, estrogen, ca-VitD, number of children, age, BMI and the number of menopausal years.

Results: osteoporosis was found in 62.2%. The osteoporosis probability scoring system cutoff value of 26.8 was selected with 89% sensitivity, 63% specificity, Youden factor of 0.53 and LR=2.4. In this score, osteoporosis probability was 98%. Area under the curve in Roc curve of osteoporosis probability scoring system was 81.4%.

Conclusion: Clinical Osteoporosis Probability scoring system with a 26.8 cutoff value is suggested for osteoporosis prescreening using Bone Mass Densitometry test.

KEY WORDS: Osteoporosis, Menopause, Risk factor, Bone Densitometry.

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INTRODUCTION

Osteoporosis is a systemic and chronic disease defined as low bone mass resulting in higher probability of bone fracture, and is a prevalent public health issue especially in older female population.[1-4] Osteoporosis is the most reliable predictor of bone fracture.[5] The frequent sites of fracture are vertebra as the most common and hip as the most dangerous.[6,7] The first year mortality of hip fracture is about 20% and its morbidity and dependency is 50%.[6] The number of elderly population is increasing because of higher life expectancy in the world, resulting in an upward trend of osteoporotic fracture incidence.[1,8] Fracture incidence is higher in Caucasian women, and lower in African Americans.[2] This race- dependency confirms the need for population specific decision- making strategies.

Early diagnosis of osteoporosis by bone mass densitometry (BMD), as a gold standard, is the main factor helping the fracture preventing in

public health plans.[9-11] Due to limitation of health resources, there is a need for more cost- effective plans in clinical practice, so BMD is not suitable as a screening test for all age categories.[2]

The goal of the present study was to formulate a clinical scoring system to evaluate people at risk of osteoporosis before ordering BMD testing.

METHODOLOGY

Three hundred and twenty five patients needing BMD were included in our study. This study was approved by the ethics committee of Islamic Azad University, Hamadan, Iran. All participants signed an informed consent before entering the study. A questionnaire containing 82 clinical osteoporosis related factors in six subgroups including age, physical activity, calcium and VitD therapy, estrogen therapy and drug history was filled for each person before BMD testing. Diagnosis of osteoporosis was based on the T-score of less than- 2.5 in L2-L4 area following WHO guidelines and more than 2.5 T-score was regarded as normal.

From 82 starting factors using backward method in logistic regression analysis we chose the 9 most related factors. We used the regression coefficient of the final model as coefficients scores to construct a Clinical Osteoporosis Probability (COP) scoring model.

Functional description of these osteoporosis related risk factors are as follow: fractures which are not explained by trauma, thyroid hormone therapy, corticosteroid therapy, estrogen therapy and calcium-VitD therapy.

Table-I: The frequency and mean-median sums of the most osteoporosis related factors.

Frequency	*N (%):*
History of fracture	18/321(60)
Thyroid hormone usage	40/191(21)
No estrogen therapy	274/323(85)
Corticosteroid usage	176/289(61)
No calcium-vitD therapy	79/157(50)
One or less M.Y.*	44/314(14)
2-5 M.Y	67/314(21)
6-10 M.Y	72/314(23)
11 or more M.Y	131/314(42)
Mean (+SD) and median (range):	
Age	57(9) and 56(23-81)
BMI	27.7(4.2) and 27.9(26.8-41)
Number of child	1.7(0.7) and 2(1-4)

*M.Y. : menopausal year

Body mass index (BMI) was formulated based on: weight in kilograms divided by the square of height in meters and the Number of children used in our study included the live birth and stillbirth of term pregnancies. It is important to consider that drug history of patients was based on using the drug for at least three months and the dosing of the drug consumption was not considered as a factor.

RESULTS

Frequency and the mean of 82 factors were calculated in 325 patients. Table-I shows the results for the most related factors. From 325 patients, 202 (62.2%) suffered from lumbar spine osteoporosis and the other 123 (27.8%) were normal.

Out of 82 factors considered to be related to osteoporosis, we chose nine factors as the most related ones based on logistic regression analysis. Among them, the most prevalent factor was a history of bone fracture indicating 21.9 times more probability of osteoporosis (Table-II).

Regression sums of osteoporosis probability were extracted for each factor and the final osteoporosis probability scoring formula was resulted considering the weight of each factor. The final score was calculated from adding each factor multiplied by its own regression sum. The highest regression sum, (21.5) belonged to the history of bone fracture (Table-II). The final formula to calculate the Clinical osteoporosis probability score (COP) score was determined as follow:

Clinical osteoporosis probability score (COP score) = RF1 × 21.5+ RF2 × 1.8 + RF3× 1.4 + RF4× 0.9 + RF5 × 0.6+ n of RF6 × 0.7+ age × 0.5 + BMI × -0.9 + Rank of RF9 × 0.4. Sensitivity, specificity, Youden factor, likelihood ratio, and osteoporosis probability were calculated in different COP scores in active osteoporosis prevalence of 62.2% (in our study group), and three presumed populations with prevalence of 5%, 10% and 15%.

Table-II: Osteoporosis regression coefficient for each risk factor (RF) in the study population.

Risk factor (RF)	*Regression coefficient*
1. History of fracture	21.5
2. Thyroid hormone therapy	1.8
3. No estrogen therapy	1.4
4. Cortiostreroid therapy	0.9
5. No ca-VitD therapy	0.6
6. Number of child	0.7
7. Age	0.5
8. BMI	-0.9
9. Rank of menopausal year	0.4

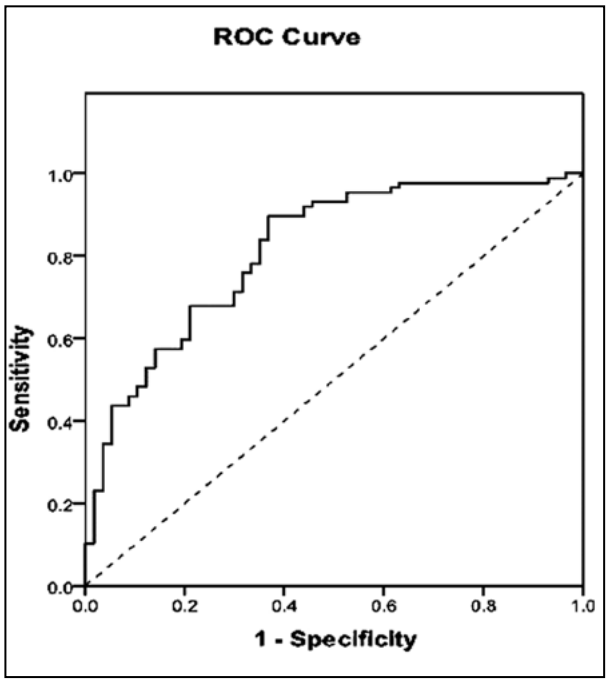

Fig.1: ROC curve of COP score system (cutoff value of 26.8) for osteoporosis case findings using BMD testing (AUC=81.4).

Based on these calculations in COP score of 26.8 osteoporosis probability in the present study was 98% and in three presumed groups with prevalence of 5%, 10% and 15%, the corresponding osteoporosis probability was 12%, 21% and 30%, respectively. We selected the cutoff value of 26.8 for COP score with 89% sensitivity, 63% specificity, Youden factor of 0.53 and LR= 2.4. The area under the curve (AUC) in ROC curve of COP score was 81.4% (Fig.1).

DISCUSSION

Osteoporosis is not a symptomatic process and progresses silently until a fracture occur, so the aim of health care for postmenopausal women should be to target osteoporosis cases before fracture takes place.[6] For example in the United States all white females above 65 years old are referred for BMD as a screening test and if there is a risk factor in a postmenopausal woman, she would also be considered for a BMD testing.[12-14]

Multiple prescreening methods are developed based on different populations, to select candidates for BMD testing. One of these prescreening methods is "Simple Calculated Osteoporosis Risk Estimation" (SCORE) which uses six risk factors including age body weight, race, HRT, history of fracture and rheumatoid arthritis as predictors of osteoporosis case finding in BMD. Another screening method is "Osteoporosis Risk Assessment Instrument" (ORAI) which uses only three factors: age, body weight and HRT. The third method is "Osteoporosis Self Assessment Tool" (OST) using just two risk factors, age and body weight. The fourth method is "Body Weight Criterion" (BW) which suggests BMD testing in women below 70kg of weight who are postmenopausal. The fifth method is "Osteoporosis Index of Risk" (OSIRIS) based on four factors including age, body weight, HRT and the history of bone fracture and finalythe sixth method is "Age, Body size, No Estrogen" (ABONE). Effectiveness of the 6 mentioned screening methods in comparison to present method are illustrated based on sensitivity, specificity and AUC (Table-III).[1,15-20]

Table-III: Comparing the effectiveness of 6 other screening methods with COP scoring.

Screening method	*Sensitivity (%)*	*Specificity (%)*	*AUC (%)*
SCORE	89-91	13-50	72-77
ORAI	80-100	10-63	32-85
OST	50-100	0-75	33-76
BW	37-93	35-51	13-76
OSIRIS	64-85	39-69	71-73
ABONE	56-83	34-48	72
COP scoring	89	63	81

Application of each model in a country needs a full knowledge of the epidemiology of osteoporosis and fractures and the cost and benefits of the intervention plans.[21] Furthermore, the scoring cutoff value might be changed based on population characteristics such as: estimated resources, different insurance service agreements, affordability of this screening test according to the number of cases who are the candidate, and the availability of drugs for treatment.

The method calculated in our study shows a sensitivity of 89%, specificity of 63% and AUC of 81.4% CI 95%=74.2-88.5. The method seems to be clinically applicable and easy to use. Some of the limitations of the present study should be considered, for example the demography of our test group who were all referral patients and the limited number of cases.

CONCLUSIONS

Clinical Osteoporosis Probability (COP) scoring system based on nine risk factors including history of fracture, thyroid hormone therapy, estrogen

therapy, corticosteroid therapy, ca-VitD therapy, number of children, age, BMI and the number of menopausal years with a cutoff value score of 26.8 is suggested for BMD testing. Future studies might improve COP scoring system by extending the number of cases, challenging its effectiveness in case finding in other populations and probable change of the cutoff value, if needed.

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